JUN 6 1921

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OUR TROPICAL TIMBER TRADE
A NEW ERA IN WIRELESS

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

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JUN 6 1921

LINKING NEW YORK CITY WITH THE MAINLAND BY THE HUDSON RIVER BRIDGE.—[See page 450]

Vol. CXXIV. No. 23
June 4, 1921

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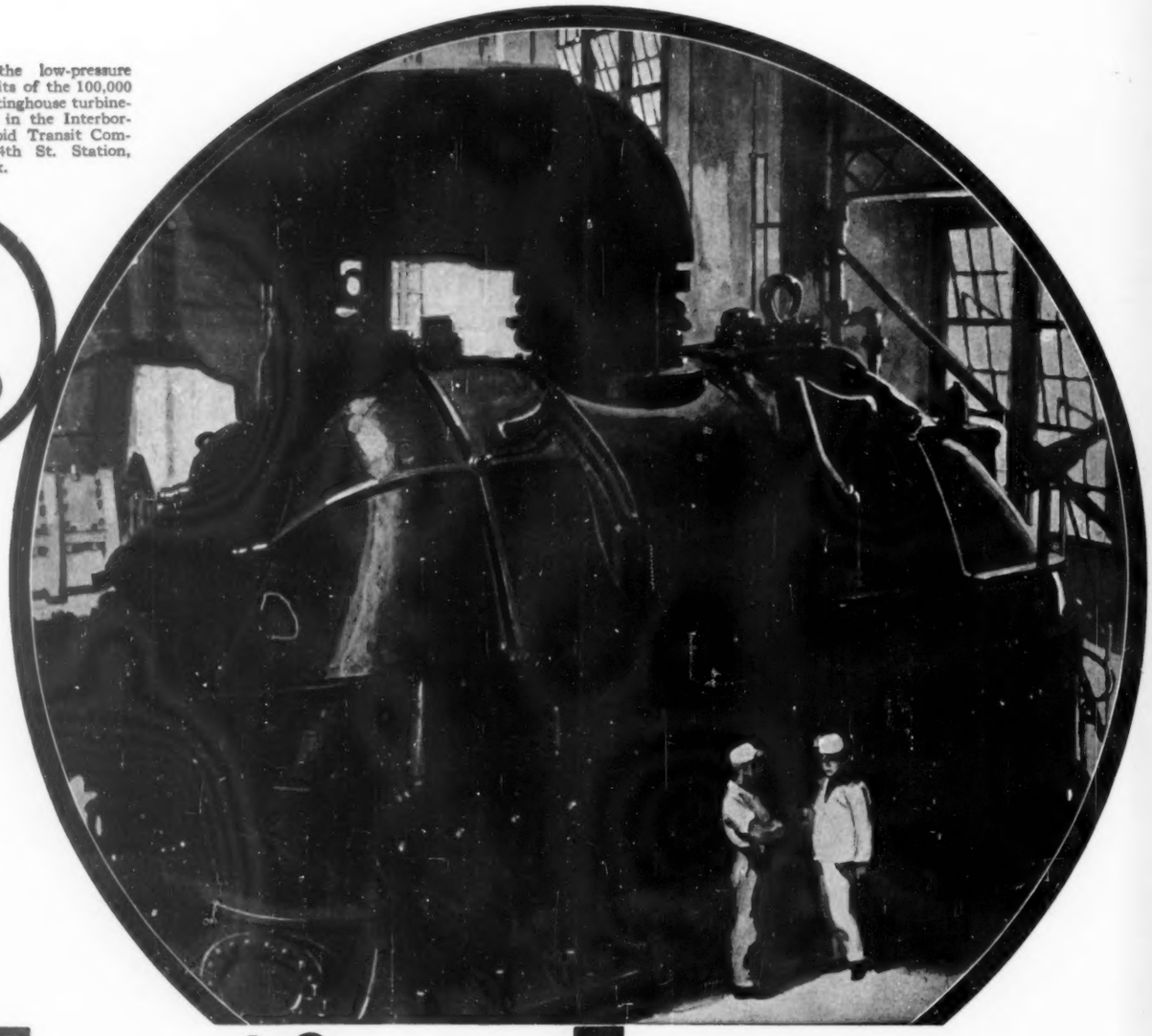

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PRIME MOVERS AND GENERATORS

SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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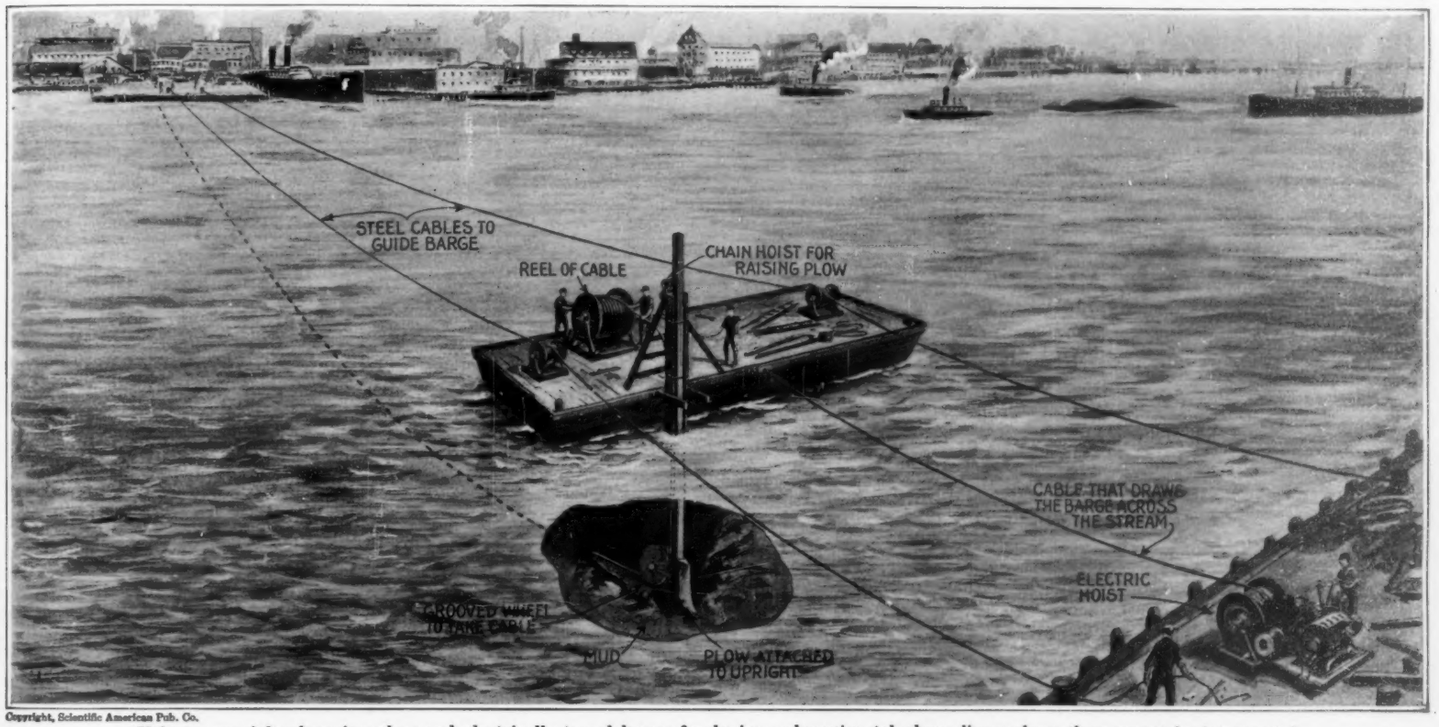
STEEL CABLES TO GUIDE BARGE
REEL OF CABLE
CHAIN HOIST FOR RAISING PLOW
CABLE THAT DRAWS THE BARGE ACROSS THE STREAM
ELECTRIC HOIST
GROOVED WHEEL TO TAKE CABLE
MUD
PLOW ATTACHED TO UPRIGHT

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Using a special submarine plow and electrically-towed barge for laying submarine telephone lines where they cannot be interrupted

A Submarine Plow for the Submarine Telephone Cable

THE danger to which submarine cables are subject in shallow water is well known, and is attested to by the fact that such cables are always designated by the well-known signs, "Cable Crossing. Do Not Anchor Here." For it is a fact that such cables are often damaged by the anchors of even small craft, with resulting inconvenience to the telegraph or telephone company and subscribers alike, not to mention the expense of repairs.

The accompanying drawing depicts how a telephone company lays its telephone cables in such a manner that they are reasonably protected against anchors, tides and other sources of trouble. A small barge carries the reel of cable as well as a combination mud plow and cable-laying device, and is hauled across the water by an electric hoist, as shown. It will be noted that a pair of steel cables are employed to guide the barge in a straight path across the body of water, while a third cable connected with an electric hoist on shore pulls the barge across.

The cable is taken from the reel on board the barge and passed down to a grooved wheel behind the mud plow and thence laid in the furrow prepared by the mud plow. The cable is soon covered over with a layer of mud and sand. The depth at which the mud plow operates may be regulated by raising or lowering the upright to which it is attached. A system of signals between the crew aboard the barge and the hoist operator on shore insures proper coordination of efforts.

New Way of Singeing Chickens

ACETYLENE has been aptly termed "the gas of a thousand uses." New uses are being discovered constantly and very many of them are as little related to other uses as may well be imagined. One of the most recent and perhaps the most curious uses is for singeing chickens.

It is claimed that the acetylene flame, properly used, performs this operation in a small fraction of the time formerly required by the old process, that it removes the last vestige of feathers from the fowl, and that the burning off is accomplished without scorching the skin or materially heating the delicate superficial flesh. That this is possible with the intensely hot acetylene flame would seem hardly possible, were it not indisputably demonstrated.

Strength of Iron Pipe Cast Centrifugally

MODERN Cast Iron Pipe" was the title of a paper read recently before the Engineering Institute of Canada, Montreal Branch, by A. F. Macallum, commissioner of works, Ottawa. His remarks regarding the De Lavaud process of making centrifugally cast iron pipe, already described in this journal, were in part as follows:

The present specifications for cast iron pipe are based on iron having a tensile strength of 19,000 lb. per sq. in. When higher standards are given under the present foundry practice and mixtures, the pipe is apt to be brittle. On account, however, of new methods being adopted in manufacturing cast iron pipe, consideration is being given to the revision of the specifications to meet these new conditions. This new pipe, developed by De Lavaud, a Brazilian engineer, is now being manufactured and introduced in this country, after exhaustive comparative tests with the ordinary standard cast iron pipe.

The writer has studied with great interest the manufacture of this new type of cast iron pipe, which involves the application of the principle of centrifugal force to molten metal when poured into a permanent mold. A regulated quantity of molten iron is introduced into a revolving water-cooled cylindrical mold, whereby the centrifugal force exerted causes molten metal to spread uniformly upon inner surface of the mold. Within a few seconds the pipe is withdrawn from the mold at a red heat. It is brittle after leaving the mold, on account of the outer surface being chilled, but after passing through an annealing furnace it becomes tough and much stronger than ordinary cast iron pipe, as plainly shown by the recent tests made by Professor Gillespie of Toronto University. The pipe made under these conditions has a decided contrast in structure to pipe cast in sand molds, and has not the segregation of impurities often found in sand cast pipe. As a consequence the pipe is a homogeneous, dense, fine-grained iron throughout, having no water or gas bubbles, and because of this density and strength can be made much thinner.

In the tests made by Professor Gillespie a 6-in. pipe made by this machine was compared with a 6-in. ordinary sand molded pipe and out of the same iron with the following results:

Centrifugal Cast Pipe: Thickness, 0.28 in. Tensile strength, 39,000 lb. per sq. in. Modulus of elasticity, 14,500,000. Modulus of rupture, 63,800. Quality factor, 20.2.

Sand Cast Pipe: Thickness, 0.51 in. Tensile strength, 16,000 lb. per sq. in. Modulus of elasticity, 8,860,000. Modulus of rupture, 33,900. Quantity factor, 9.8.

From this it will be seen that the centrifugal pipe has very high tensile, cross-bending and resistance to shock values.

It is apparent, therefore, that this type of pipe can be successfully made much thinner than the sand molded pipe. For example, a 12-ft. length of 6-in. pipe weighs 280 lbs., as compared with 430 lbs. for a sand cast pipe of the same diameter.

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Hudson River Bridge Equivalent to Twenty Tunnels

WE were asked the other day—and the question had been put many times before—why a bridge is preferable to a tunnel as a means of crossing the Hudson River. We answered that a crossing, such as will be provided by the Hudson River Bridge, is equal to twenty tunnels in capacity, and can be built for less than half the money.

Somebody has stated that nine-tenths of the make-up of a genius is his possession of a keen, quick sense of proportion. Life-education for most of us consists in a struggle to lift ourselves mentally above the non-essentials of life into the free atmosphere of the few great essentials. The men who possess a keen sense of proportion get results and get them quickly. They dwell among the high peaks of thought and action; whereas the majority of men get lost among the non-essentials, and fondly thinking that they are upon the mountains, they spend their lives in the shadows of the valley.

It is for lack of a broad vision of the problem that New York City has allowed the Hudson River to cut it off physically, commercially and, we had almost said, politically, from the continent of America. Lack of a sense of proportion led the city to attempt to obliterate the Hudson River piecemeal, by driving tunnels beneath its bed, each capable of accommodating only one line of rails.

Thirty years ago a few men, such as President Rea of the Pennsylvania Railroad, and his great predecessor, Mr. Cassatt, together with Gustav Lindenthal, the bridge engineer, had sufficient sense of proportion to realize that big problems call for big solutions; and so it came about that the scheme for eliminating the barrier of the North River by building one vast suspended highway for freight and passenger travel was placed before a startled and incredulous public.

A bridge with a clear span of 3,200 feet, capable of carrying the heaviest freight and passenger trains? Impossible! Hence, for lack of vision and a true sense of proportion, New York has been burrowing under the river in leisurely fashion, with the inevitable result that the rising tide of twentieth-century travel has overtaken and swamped us. Congestion, increasing in geometrical ratio, stares the public in the face. Delays and discomforts multiply in passenger travel, and in freight traffic it costs as much to get a ton of merchandise from New Jersey yards to its destination in greater New York as it does to haul it half a thousand miles across the continent by rail.

Bridging is better than tunneling because by building a bridge big enough, it is possible to solve the problem at a single stroke, instead of scattering our effort in building a score of individual tunnel units. Moreover, the total cost of the twenty tunnels would be just two-and-a-half times as great as the cost of providing equal traffic accommodations by the construction of one great bridge.

Now, let us look at this matter more closely. To accommodate the great flow of automobile and motor truck traffic for which provision is made on the 200-foot upper deck of the Hudson River Bridge, would call for the construction of ten two-track tubes, similar in size *and costly ventilating plant* to the tunnels which are about to be built under the Hudson at Canal Street. Now these ten tubes, judging from the estimated cost of the Canal Street tunnels, would call for the expenditure of 150 million dollars. Hence, the upper deck of the Hudson River Bridge alone will have a traffic capacity which, if provided for by the tunnel system, would call for a 150-million-dollar investment.

On the lower deck of the bridge there will be provision for ten railroad tracks capable of carrying the heaviest transcontinental passenger and freight trains. To provide equal accommodation by the tunnel system would call for ten separate railroad tunnels whose total cost at present prices would be 100 million dollars.

Now, the estimated total cost of the Hudson River Bridge is about 110 million dollars, and hence it follows that, by the erection of this monumental structure, the cities of New York and New Jersey and the whole metropolitan area will have at their disposal a means of communication which, if it were provided by the tunnel system, would cost two-and-a-half times as much. In other words, one bridge above the river is equal in capacity to twenty tunnels beneath the river; and it can be completed in less time and at less than one-half the cost.

Hydrographic Office Should Remain with the Navy

THE McCormick Bill, introduced by Senator Knox, which provided for the transfer of the Hydrographic Office from the Navy to the Department of Commerce, died with the last Congress—fortunately so, for the proposed transfer would have been very ill-advised and vicious. The question of transfer, however, will undoubtedly be raised in the Congressional Joint Commission to reorganize the Governmental departments, which Commission, by the way, has just elected Mr. Walter R. Brown, the President's representative, as its chairman.

The absolute need of an office under the Navy Department whose duty it is to provide all our naval vessels with up-to-date charts, sailing directions and other information relating to the sea and navigation, was realized early in the career of our country. Under the naval officers in charge, we were pioneers in the study and investigation of ocean currents, marine meteorology and terrestrial magnetism, with its effects on the mariner's compass. Under their direction our naval vessels made many hydrographic surveys in different parts of the world. Our Hydrographic Office initiated the Pilot Charts, which are issued monthly of some oceans, quarterly of some others and which are of inestimable value to all seamen. Other great maritime nations have followed our lead.

The primary purpose of the office, which must not be lost sight of, is to keep our Navy and its ships in all parts of the world supplied with charts, sailing directions and a vast amount of the latest marine information with all changes to date. *The Hydrographic Office is a vital part of the Navy itself and its work cannot be done by civilians in another department.* Without proper data and marine information of the kind furnished by this office, our naval vessels could not operate safely either in peace or war. The maintenance of the Hydrographic Office under the Navy Department is just as essential to the efficiency of the Navy as is its Bureau of Ordnance.

In addition to its primary purpose, the Hydrographic Office incidentally furnishes to the merchant marine much of the same information (but, of course, the office has much confidential data and many confidential charts which are furnished only to naval vessels). The scope and value of the information given to the merchant marine has been greatly developed and increased by the ability and wisdom of our naval officers, and its value to merchant sailors cannot be overestimated. Merchant sailors fully appreciate it.

No other department of the Government is, or can be, as well equipped as the Navy to investigate, collect from all parts of the world, compile and distribute this information. No civilian in the Department of Commerce or elsewhere can have the same realization of what is needed by sailors as have our naval officers—educated, practical seamen and navigators—nor can a civilian have the same vital interest in the work. No civilian department can make sure of supplying every ship of the Navy, wherever she may be, with every chart she may need, with corrections to date.

If this one activity were to be transferred from the Navy to the Department of Commerce (and presumably to the Coast Survey), what would it mean? It would mean, unless the efficiency is to deteriorate greatly and immediately, that the Coast Survey must be immediately supplied with a considerable fleet and large personnel to survey in many different parts of the world in order to do work that is now being done daily, quietly, efficiently and economically by naval vessels stationed in those waters, at intervals between the performance of other naval duties. Naval officers have made surveys in Korea, China, Mexico, Central America, Brazil, Uruguay, South Atlantic, South Pacific, Indian Oceans, and in many other places—waters of countries which do not have fully equipped hydrographic offices of their own. These surveys involved very little additional expense. If, however, similar surveys are to be carried on by the Department of Commerce, the expense of sending ships to any one of these places will be great, for they will have no other reason for going. In fact, the cost will be so great that comparatively few of the needed surveys will be made.

The Impo. tance of Instincts

IT is commonly supposed, in popular conception, that in the lower animals reason plays at most a subordinate rôle while instinct reigns supreme; and that in man the condition is reversed, instinct regulating for the most part only the more elemental functions, while the more complicated phases of conduct are determined chiefly by reason.

That instinct performs, especially among certain insects, functions which to us appear almost miraculous, will not be denied by any student of nature. In this respect there seems little occasion to revise the popular conception. But there is much reason to suspect that the rôle of instinct in human affairs is commonly much underestimated. The fact is that reason alone furnishes no *motives* of any kind for action. If we could imagine a purely reasonable being, devoid of emotions and feelings, this creature of our imagination, to be consistent, must be thought of as wholly inert. There would be no pleasure or pain to make it seek one course and shun another. It might be endowed with full and perfect knowledge of the consequences of any action that it might elect to perform; but having no feelings it would be wholly indifferent to such consequences, and would make no selection in favor of one line of action in preference to another.

It may be urged that reflections on such an imaginary being are hardly even of academic interest. They derive, nevertheless, a certain utility from the circumstance that we can often more clearly perceive a fact or a relation if we consider an extreme example, even though this example be a mere imaginary abstraction, a sort of caricature of the things having real existence. It is true that a wholly emotionless, feelingless person, in full possession of rational faculties, is at most a figment of the imagination. But though such an extreme case can never have real existence, men do differ widely in the intensity of their emotional makeup, and there is much reason to believe that these differences in temperament, rather than differences in intellectual endowment, determine the place that each man is fitted to occupy in the social scheme. For, as Young has said, "With the talents of an angel a man may be a fool." It is not enough to *be able*, there must be a strong impulse to *do*.

Among the most powerful impulses that drive men to accomplish—powerful, often, especially among those of large endowment—is the instinct of workmanship and self-expression. With such persons creative activity is not primarily a calculated means toward a material end; it is the direct following of an imperative impulse that brooks no disobedience. For, to quote Owen Meredith, while talent does what it can, "Genius does what it *must*." Lowell, in advising a prospective author as regards the acquisition of literary style, tells him that the first requirement is to have something that "Will not stay unsaid." Similarly Arnold Bennett says of the author that "He cannot keep himself to himself, he is bound to tell." And elsewhere he says: "The artist works under the stress of instinct." We need not hesitate to say that the same is true of the great creative worker in any field, whether it be science, commerce or what not. Speaking quite generally, the greater a man's achievements, the stronger is the presumption that he was impelled, unconsciously perhaps, rather by the blind instinct to use his talents to the full, than by any thought of material reward.

Thus instinct plays, indeed, a most significant rôle, not only in the regulation of our prime, our most elemental functions, but also in directing human endeavor in the very highest flights of which it is capable.

Naval and Merchant Marine

Triple Turrets Becoming Universal. — The system of mounting three guns in a single turret, first used in the Italian battleship "Dante Allighieri," and later by the Russians, Austrians and ourselves, bids fair to become universal. The recent target practice against the "Baden" was made by British 15-inch guns mounted in an experimental triple turret.

Suez Canal to Be Tunneled. — The great military base at Kantara, from which the British built a military railway through the desert to Palestine, is being dismantled. The line, of course, is permanent. During the war the Suez Canal was crossed by a large swing bridge, which is now to be dismantled. Connection between the Egyptian railways and the new line to Palestine will be maintained by means of a tunnel which will be built below the Suez Canal.

Ship's Gear the Complement of Wharf Cranes. — The New York-New Jersey Port and Harbor Development Commission, in its recent report, states its belief that a ship's gear plays a useful part in coöperation with wharf cranes in promoting rapid loading and unloading of cargo carriers. Ship's gear is standardized equipment. It is found on every ship, and its use is universally understood. Wharf cranes should be designed with the idea of coöperation with the ship's own hoisting gear to secure the quickest loading and unloading results.

Yacht Speed Fifty Years Ago. — In the course of some historical articles on the performance of early yachts, the *Yachting World and Marine Motor Journal* gives some interesting details regarding the famous schooner "Alarm," of 248 tons, built in 1830 at Lymington, England, as a 193-ton cutter, lengthened and enlarged to 248 tons and converted to schooner rig in 1852. In a race of 52 miles against the Swedish schooner "Sverige," of 280 tons, the "Alarm" won by two minutes, at an average speed of 12 knots. That would be good going in these days for a schooner of that size.

Fleet Flying Boats.—We have heard much lately of fleet submarines. The latest development is the fleet flying boat—that is, craft which, unaided, can cruise with the fleet. The new boats built for the British navy are known as the Felixstowe Fury type. They weigh 15 tons, have a wing span of 140 feet, Rolls-Royce engines, with a total horsepower of 2400, giving a range of about 1500 miles. They have a crew of seven. These boats will go out with the fleet and will remain with it. When not scouting, they will taxi on the surface; and the hulls have been constructed of sufficient strength to enable them to face heavy weather.

"Fuel for Nothing." — The case of a motor ship that trades between Europe and America without having to pay for fuel is mentioned by *Motor Ship*. The "Buenos Aires," running between San Francisco and Scandinavia, loads up with 1,500 tons of fuel oil at San Francisco, sells 800 tons at Stockholm, and returns to America with some oil left in her tanks, having used 600 tons out of the 1,500 tons of her supply in her engines. She pays 7,500 pounds for her oil in San Francisco and sells 800 tons of it at Stockholm for 8,000 pounds. The fuel is carried mostly in the double bottom, and therefore does not detract from the ship's cargo-carrying capacity.

The State Canal Under State Control.—The passing of the New York State Barge Canal into complete State control is naturally hailed as a good augury for the future prosperity of the waterway. As part of this movement, the Government is disposing of the fleet of canal boats, some of them self-propelled, which was built during the war, especially for this service. The fleet is thoroughly modern and represents some careful thought and planning. It is hoped that the bids will approximate the present value of these craft and that a reputable organization desirous of furthering canal interests will secure this fleet. Otherwise, it will be sold to individual speculators for what it will bring, and the boats will be scattered.

"Bismarck" to Be Named "Majestic." — The German liner "Bismarck," sister ship to the "Vaterland," now the "Leviathan," is nearing completion at the yards of the Blohm and Voss Shipping Company at Hamburg. This ship, with a length of 950 feet and a beam of 100 feet, will have a gross tonnage of about 56,000. The builders claim that she will be a better boat than the "Vaterland," the experience gained in that ship being embodied in her. The "Bismarck" was handed over to the Allies under the terms of the Treaty, and has been sold to the White Star Line, who will rename her "Majestic," when she hoists the company's flag and takes her place in the service from New York to Europe.

Science

Lightning Freak.—Lightning is apt to do anything which is irregular. It struck a Dickenson College dormitory and hurled a freshman seven feet across a room while others a few feet away were not touched.

Highest Mountain in England for Sale.—Who wants to buy Mount Snowdon, which is the highest mountain in the British Isles? It is now listed for sale by its owner, Sir Richard Williams Bulkeley. Sir Richard is probably the largest land owner in Wales.

The High Cost of Education.—It will cost Columbia University $7,271,393 to carry on the way for the fiscal year beginning July 1st. Twenty-four states of the union have annual budgets of less than this. Columbia will expend $4.173,168.29 for administration and $536,108 for the care of the buildings and grounds. Miscellaneous items make up the balance.

American Unearths Ruins of a Greek City.—Ruins of a prehistoric city have been discovered by Professor Carl Blegen of the American Archaeological School at Athens. The city he has found was situated between Corinth and Mycenae, in southern Greece, and pottery and fragments of statuary unearthed fix the date of its prosperity at about 2000 B.C.

A Sight-Saving School.—A sight-saving public-school has been formed in a school in Canada. It is located in a large and specially lighted room and there are a dozen pupils to start with. Ordinary text-books are done away with and special books with very large type (24-point type) are used. Pen and ink as well as white paper is discarded. Instead soft pencils and a cream shade of paper with green lines are used. When it is borne in mind that 24-point type is ½-inch high, this scheme does not seem to be very practical in the case of the already bulky text-books.

Saved with Dynamite.—A thrilling story comes out of northern Ontario. The women of an Indian encampment were attacked by timber wolves while the men were absent trapping. With the few rifles left in the camp the women defended themselves until the ammunition gave out and their situation became perilous. An Indian boy thought of some sticks of dynamite for use in lakes when fishing was bad. A bundle of them with caps and fuses was thrown among the wolves and the explosion killed 36 wolves and frightened off the remainder.

Reading in Bed.—An English scientist after an exhaustive study of the eye and eye strain says that reading in bed is not harmful provided one sits up and looks down at the print, the light of course being good. Looking at pictures in an exhibition is always very tiring to the eyes. The cause goes back to the time when man and the higher apes first developed the use of the opposing thumb. The object picked up and held with the aid of the thumb was held below the eyes. Thus the muscles that turn the eyes down became more used than those which turn the eyes up and less sensitive to strain.

Rifleman to Guard Fish. — One of the most novel jobs in the United States is held down by a man in Oregon. The State Legislature has just commissioned him official sea lion hunter and he is to work in coöperation with the State Fish Commission to rid the coast of Oregon of the sea lion menace which destroys more fish than all the famed canneries of the district combined can pack. For bounties the hunter has brought in over 10,000 sea lions. Thousands of tons of salmon are destroyed annually by the peculiar land and water beast against whom the hunter wages merciless warfare. The secretary of the State Fish Commission states that during the 157 days which constitute the open season, and during which the canneries are allowed to operate, sea lions along the coast consume 41,500,000 pounds of salmon.

Imported Brick a Colonial Fable.—One of the institutions of the middle Atlantic States is the house that was "built of brick brought from England as ballast." All other houses crumble and decay, or at least get greatly out of repair, but these seem to have a charmed existence. The importation of brick into the North American colonies, especially into Maryland and Virginia, must have been the leading industry of that period, and the records must be out of joint because they do not contain references to this important trade. The Custom House records are silent on this point. Excellent deposits of clay were found in Virginia and Maryland. Bricklayers or "brick masons" as they were called, were among the early settlers and they probably did not wait until the ships came in, "in ballast." It is a curious example of the survival of a story which is far from true and we can vainly scan the houses at Annapolis or Yorktown for true examples of English brick.

Electricity

Electricity vs. Horses.—If a horse could deliver horsepower, then it would take 19,000,000 of the 23,000,000 horses in the United States to furnish power now supplied by central electric stations of the country, according to *Electrical Review*. In 1902 less than 1,500,000 horses would have sufficed.

Electrification of Philippine Railroads. — In regard to the plans of the Manila Railroad Company for the use of electric motive power on its road, the Bulletin of the Philippine Government Commercial Agency in New York states that the electrical power will be developed from the Agno River, in central Luzon, which is believed to possess a potential capacity of from 12,000 to 15,000 horsepower. A thorough topographical survey of the entire water power site is being undertaken, and early reports of the survey would seem strongly to point to the feasibility of the project.

Electric Locomotives for Brazil.—The electric locomotives for the Paulista railroad in Brazil, which was recently described in our columns, are now being built in the United States. In fact, the first of these has been completed. It is a freight locomotive weighing 105 metric tons and has six driving axles, each equipped with one 280-horsepower direct-current motor, arranged for operation with two motors in series on the 3000-volt line. This locomotive has been designed to handle trailing loads up to 700 metric tons over a line having a maximum grade of approximately 2 per cent.

Water Power in Halifax. — A plant is under construction at St. Margaret's Bay, about 15 miles from Halifax, which is expected to furnish sufficient light and power for the city, according to a report from our Consul. This is under the direction of the Nova Scotia Commission and will mark the partial completion of its first important development. The question is yet to be decided whether the Halifax municipality or the street car company will receive and distribute the power. Other private interests are constructing plants which will utilize the tremendous river force of Nova Scotia.

An Anti-Glare Lamp.—From England comes the good news that Mr. Alfred E. Terry has invented a useful apparatus which abolishes the usual diffused glare from motor car lamps, and enables drivers in the opposite direction to see whether the road is clear. It consists of a grid composed of thin aluminum plates crossing at right angles and forming a network of square tunnels about ⅜-inch wide and 2 inches long. These are held in a frame which fits on to the lamp. The result is that the beam is concentrated about 4 feet or 5 feet in front of the lamp, whence it widens out to give sufficient light laterally, while at the same time an increased range directly ahead of some 20 yards compared with bare lamps is obtained. A demonstration shows that glare is largely avoided.

Automatic Heat Regulation of Electric Cars. — Among the new devices that are being introduced in electric railroading are the automatic heat regulators or thermostats. These devices, it is said, save over 50 per cent in the consumption of current by the heaters, and save over 10 per cent on the peak load. Furthermore, they are said to reduce the cost of maintenance on heaters for the reason that they prevent overheating with its destructive effects. The mechanism of the thermostats is quite simple. The mercury tube is mounted on springs and is not affected by vibration or jar of the car. The metal conductor around the mercury bulb makes contact on the outer case and transmits the temperature of the air on the outside of the case so readily to the mercury that the manufacturers guarantee it to regulate within one degree. Something like 19,000 of these thermostats are now in use.

Telephonic Measurements. — In a paper by Sir William Noble on "The Long Distance Telephone System of the United Kingdom," recently read before the Institution of Electrical Engineers, some interesting facts are brought forth regarding delicate telephone measurements. It is pointed out that the developments of recent years have extended the practical limits of telephonic science. Thus measurements and adjustments of the capacity and resistance of cable conductors are now made to an extreme degree of accuracy at frequencies of 800 cycles per second and higher. The amplifiers used are exhausted to a pressure of 0.00001 mm. of mercury, probably the highest vacuum employed in commercial apparatus. These methods and devices, the employment of which a few years ago was possible only in the best-equipped laboratories, now form part of the standard construction and operation of long-distance telephone plant, and are the everyday concern of the telephone engineer.

Our Tropical Timber Trade

Some of the Valued Woods for Which We Must Rely Upon the Countries to the South of Us

By Samuel J. Record, Professor of Forest Products, Yale University

THE timbers we derive from the tropics are the gold-nugget woods of the forest. Our demand has always been for the unusual and fancy, for woods prized for their beauty, their fragrance, their medicinal virtues, or some other special and peculiar property. There is reason to believe that this condition is going to change with the vanishing of our virgin forests, but the only contribution the vast tropical forests have so far made to our timber market is limited to special woods for special uses.

Our greatest demand on the tropical forest is for furniture wood. First in importance comes mahogany, the premier of the cabinet woods. It is of long established and enviable reputation; but not all that appears on the market under that name is genuine. There are but four species of true mahogany known and they grow naturally only in the West Indies, the Florida Keys, Mexico, Central America, and northern parts of South America.

The center of mahogany production is now in Mexico and Central America. The business is controlled by a few companies who handle all of the operations from the woods to the manufacturer. Here is one of the few instances where the crude and desultory native methods of logging have given place to organized effort. The trees are cut, the logs squared, hauled out on the beach at low tide, roped together into rafts to be towed to navigable water and later hoisted aboard a steamer bound for an American port. The sawing is done in this country because logs are more rapidly handled than lumber and milling conditions here are more satisfactory. Much of the finely figured mahogany is cut into veneers.

Most of the African mahogany, closely allied to the genuine, comes from the Gold Coast and neighboring regions. The trees which supply it are usually of very large size and in squaring the logs the natives fairly swarm over and about the prostrate trunk. It is a hard struggle to get the timbers to the railroad and arrived in the yard it is a common practice to thatch them with palm leaves to ward off the intense sun. There is also considerable lumber from the Philippines sold under the trade name of "mahogany." In fact a tropical country is poor indeed that cannot produce from one to a dozen "mahoganies." It is reported that the wood of the sandbox tree, the possum-wood of Dutch Guiana, is soon to make its debut on our market as yet another "mahogany," this time a white one. The term "white mahogany" is now often applied to the prima vera.

One of our favorite furniture woods is the Circassian walnut, though this can hardly be classed as a tropical wood. It has the good cabinet qualities of our native black walnut but the wood is more conspicuously figured. There are various tropical woods called "walnut" for commercial purposes, though they are not common in our market. The so-called Brazilian "walnut" is what is known locally as the frei-jorge. It produces valuable lumber and is being shipped in quantity to Europe for use in place of oak for cooperage.

The Spanish cedar or cedro, cousin of mahogany, is extensively used in this country, almost exclusively for cigar boxes. It is a cedar only by courtesy and owes its trade name to its cedar-like fragrance. Most of our supply comes from the mahogany forests and the two woods are handled together. Thirty-six different species of cedro have been found in various parts of the American tropics. It is one of the most valuable woods locally for construction purposes and it is not unlikely that it will before very long be used for house siding in this country.

We normally consume about 3,000 tons of boxwood. The Turkish and Persian boxwood, the finest textured and most homogeneous wood known, formerly ruled the market, but is now very rare. It is an ideal wood for engraving, for instruments of precision, and for

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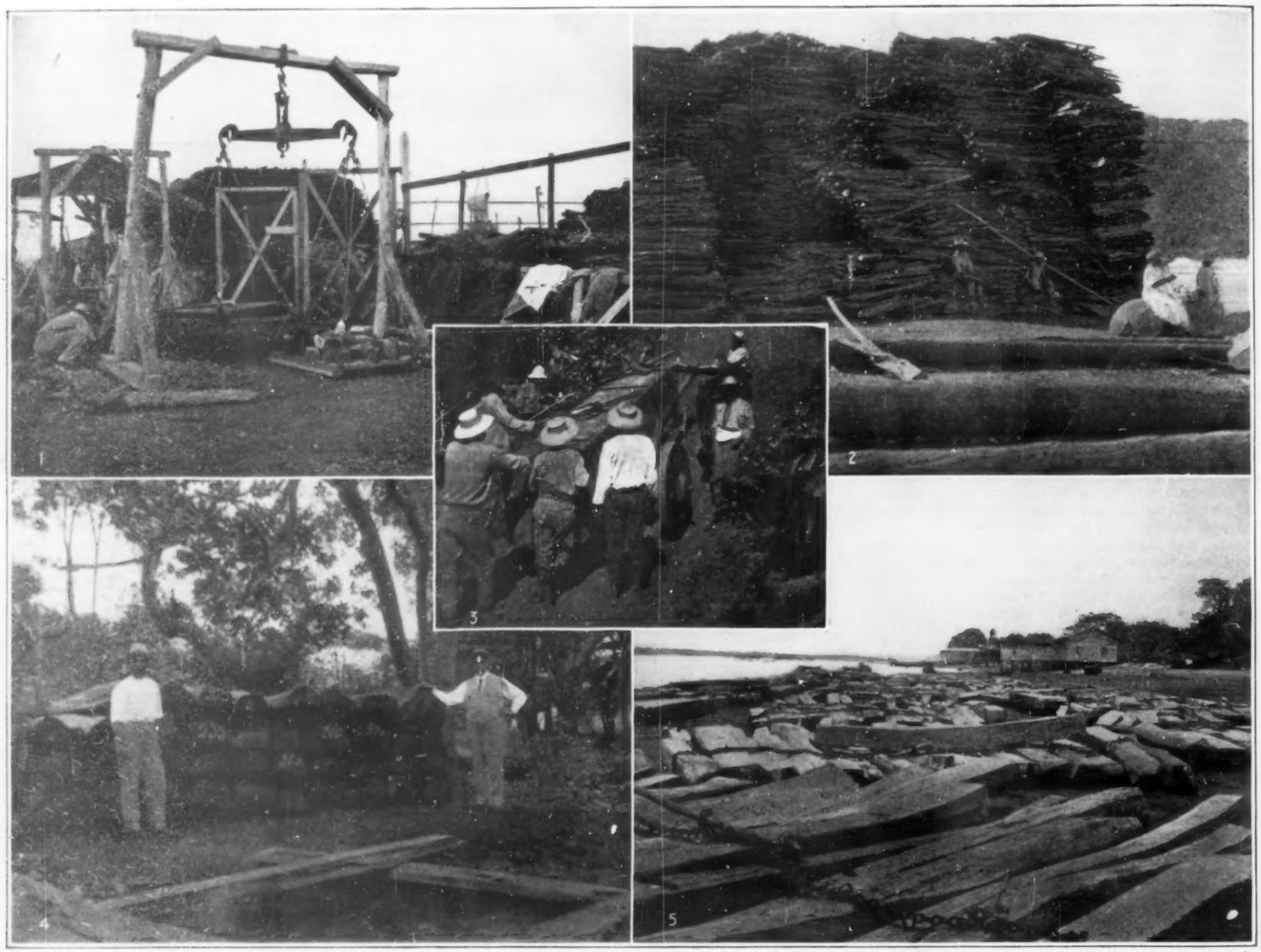

1. Preparing a batch of logwood for weighing (Hayti). 2. Pile of straight Haytian logwood ready for export to the United States. 3. Hauling out a squared cedar log from the Central American forest, on ox cart with solid wooden wheels. 4. Pile of Brazilian rosewood for veneer, sawn in half by pit saws and all heart defects removed. 5. Rafts of squared mahogany and Spanish cedar on the beach awaiting high tide

Tropical forest products on their way toward shipment to United States ports

The Burning Mines of the Hocking Valley

By Harry A. Mount

ONE spring day in 1884—thirty-seven years ago—guards in seven mines in one of the finest bituminous coal fields in this country simultaneously discovered fire in their mines. The miners were on strike and it had been rumored the day before that strike-breakers were on the way. Oil cans scattered about the mine entrance gave evidence that the fires were the work of vandals.

Today the fire is still burning. It has rendered almost useless the entire coal deposit, extending over some seventeen square miles of territory between the little mining towns of Shawnee and New Straitsville, Ohio; it has actually destroyed more than 15,000,000 tons of coal under about 1,500 acres of this territory; it has turned a once prosperous community into a graveyard of hopes. Those few miners who still eke out an existence by working the outcroppings of coal in the fire district do so at the daily risk of their lives.

The fire has resisted elaborate efforts made by the state to save this enormous store of fuel and numerous efforts of private firms to save their property. The fire is burning more fiercely today than ever before and experts of the Ohio Bureau of Mines say it is just getting a good start! It is predicted that it will burn for nearly a century to come with little hope that it can ever be extinguished.

The fire is in a particularly fine vein of coal in the Hocking Valley district. Nearly the whole vein is practically free from slag and is from five to twenty feet in thickness. That part which already has burned averaged about ten feet in thickness.

The fire is particularly difficult to control because of the fact that most of the coal is near the surface, running from ten to fifty feet deep, much of it being suitable for stripping operations. As the coal burns out the ground sinks, causing fissures in the earth through which the fire receives a new supply of oxygen.

Not only has the fire destroyed an enormous store of good coal, but it has wrecked a whole countryside. Lands have been burned brick-red by the great heat from beneath, destroying all vegetation and rendering the ground unfit for cultivation. Scores of homes have been abandoned and have tumbled into the sink holes that engulf the country in the wake of the fire.

One whole village, the town of Old Straitsville, has been abandoned. Wells in this vicinity are sometimes boiling hot and there are steaming streams running through woods in which the trees have been burned off at the roots and have toppled over in confusion. Occasionally the pent-up energy of the burning coal bursts forth in a miniature volcano, and at night scores of these craters can be seen from a hilltop in the heart of the fire district. Paved roads have been undermined and have sunk in. In brief, the fire district presents a picture of the utmost desolation. The few persons who have remained with their lands are retreating stubbornly before the advance of the fire but without hope. Only those mines in which it is possible to secure good ventilation can be worked and even then they have to be abandoned long before the fire actually reaches them because of the presence of the deadly fire damp.

One miner owned a considerable section of rich land and was moderately wealthy. The single opening he can work will soon have to be abandoned and it furnishes now a meager living by hauling coal from it in wagon-load lots. One day last summer his small herd of cows went into the entrance of an old mine, attracted by the cool shade, and next day he found them there all dead from fire damp. Their bones are now cremated.

The writer came upon a gang of five men in the heart of the fire district engaged in making a new entrance to an outcropping vein. The entrance they had used the day before was now a roaring furnace. During the night the fire had broken through from an adjoining shaft. There was an explosion that shook the surrounding country and which blew a twenty-five foot crater in the hillside. This formed a sort of natural flue for the burning mine and flames roared fifty feet into the air. The men intended to blast down the burning section of the mine to retard the fire while they opened another entrance. This would allow them to work a few more days before the fire caught up with them.

About a hundred feet from where they worked was a stream of steaming water, which, they said, was hot

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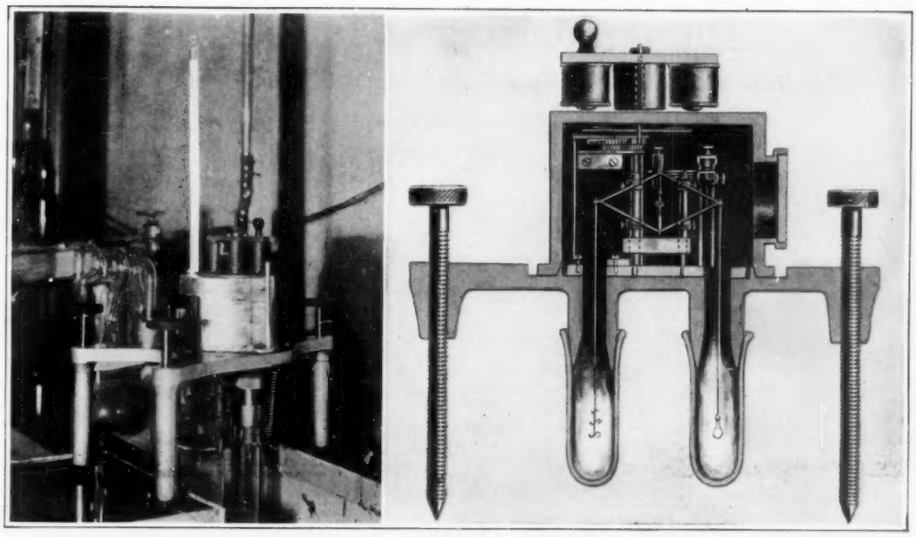

The quartz-fiber micro-balance that is sensitive to a millionth of a milligram, and a drawing showing its construction

Weighing the Ten-Millionth of a Milligram

By Dr. A. Gradenwitz

WHEN a young Swedish physicist, Dr. Hans Petterson, in the fall of 1911, commenced his work at the University College, London, the subject suggested to him by Sir William Ramsay was a closer investigation into a curious phenomenon observed by himself, viz., the temporary loss in weight of a tiny gold capsule raised to a red heat. The quartz micro-balance designed by Steele and Grant was to be used in this connection and the newcomer to Sir William's laboratory was to try even to improve it, so as to make it stronger and less difficult to work with. This difficult problem was solved most satisfactorily, the work being later continued at Stockholm.

The knife-edge support of the balance was replaced by a suspension consisting of a pair of quartz fibers, a magnetic arrestment being employed. The thinnest portion of these fibers, viz., the portion bent during oscillations of the balance, is only a few thousandths of a millimeter thick, thus being invisible to the eye and requiring, to be made visible, a strong side illumination under which it appears as a rainbow-colored gleam, the tint indicating the thickness of the fiber. The bearing capacity of these extremely thin fibers was found to be unexpectedly high, amounting to several grams, which corresponds to the strength of hardened steel. The drawing out of the fibers is effected in a few moments in the oxygen flame at a temperature corresponding to a white heat. This does away with the whole laborious work required in sharpening and adjusting the knife-edges used in connection with ordinary balances. The fibers are also of a remarkable flexibility, thus enabling the sensitiveness to be driven to figures so far unheard of. Moreover, on reducing the thickness of the fibers the flexibility will increase more quickly than the bearing capacity decreases so that the new micro-balance, in opposition to all those so far constructed, will work the better as it is made smaller.

The construction of the first micro-balance designed on these lines demanded several months' laborious work, though, on account of the unprecedented sensitiveness obtained, it proved to be worth all the pains taken. When Dr. Petterson's work was continued at the University of Stockholm, the street traffic, during those nights when the most delicate tests were made, was deviated from the university building.

The beam of the balance is entirely of quartz. In the one recently constructed it is only 5 centimeters long and weighs a fraction of a gram. Weighings are taken in a hermetically closed case inside of which the air pressure can be reduced as far as a very high vacuum, thus varying the upward pull of the air on a minute air-filled sealed quartz bulb suspended on one side of the balance. The variation thus produced in the effective weight of the bulb can be calculated with an accuracy of fractions of

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Left: A fissure in the ground through which red hot earth can be seen. At night such spots as this dot the countryside with cherry-red patches. *Right:* The day before this picture was taken work was going on as usual in this shaft; now it is a roaring furnace

Scenes on the ground under which Ohio's great subterranean fire rages

Revolutionizing an Industry

How Modern Machinery Is Minimizing Hand Labor in Hemp Production

By George H. Dacy

TIME was when the sweat of the brow, the bend in the back and the utter fatigue of the laborers were the barometers which accurately recorded our domestic progress in hemp production. The limiting factor which restricted the culture of hemp and which prevented the rapid expansion of the industry was the human labor item. Much of the arduous, age-aiding work had to be performed by hand. Only the most robust and rugged laborers were able to stand up under the severe strain of year-round activities of this description.

Inventors devoted their most able energies toward the perfection of mechanical devices which would take the backache out of hemp breaking. Despite the combined efforts of science and industry, the practical solution of the problem eluded all these technically and practically trained sleuths until the last decade. The various early models and designs of hemp harvesting and breaking machinery, however, acted as stepping stones which gradually led to the perfection and commercialization of field implements and mill appliances which now have stabilized the business of hemp farming and which have reduced the problems connected with the culture of this crop to as simple a basis and system as those that are involved in the production of corn or the small grains.

All hemp was formerly broken by hand—a back-breaking, arduous job

Hemp is produced principally in this country for fiber although the foreign supplies of hemp are also utilized for seed and for medicinal purposes. In the United States, the greater part of our annual domestic supply is used in manufacturing commercial twines and wrapping cords and to a limited extent also for the manufacture of ropes and binder twine. Hemp tow is used as oakum for caulking ships and for packing in pumps, engines and other machinery. Our present production of hemp is insufficient to satisfy the demand for commercial twines so that little attempt as yet has been made to develop the other possibilities of this remarkable fiber crop. It is also valuable for the manufacture of bagging for cotton bales, for sacking of all kinds, carpets, rugs, seines, nets, fishlines, sewing threads of all description, warp for carpets, and for such fabrics as crash toweling, rough sheeting and rough clothing.

On account of its great tensile strength, its water-resistant properties and its ability to withstand wear, hemp is well suited for cordage of all kinds, for lines and ropes used in all shipping operations, for canvas, for all purposes where strength and durability rather than beauty and fineness of texture are desired. Hemp is much like flax in chemical and physical properties and this resemblance has been capitalized by the use of efficient power-driven machinery. By a process known as hackling the hemp fiber is reduced to a condition like the coarser grades of dew-retted flax and can be subsequently spun on flax-spinning machinery.

Harvesting hemp with a modern machine which cuts and spreads the stalks

In the neighborhood of 42,000 to 45,000 acres of hemp are annually grown in this country, the yields of fiber ranging from 1,000 to 1,500 pounds to the acre. Hand labor is no longer necessary in producing and harvesting the fiber, field implements now being available which simplify the production of the crop. Specially equipped mills have been constructed and established in sections where hemp is grown on some scale for separating the fiber from the stalks. Wisconsin, which grows about 8,000 acres of hemp a year and ranks as the second state in the country in total acreage and production of fiber, has developed her industry during the last ten years and now operates 11 of the 18 hemp mills to be found in the United States.

Hemp is an annual plant which attains a height of from 5 to 15 feet and is of value due to the fiber contained in its woody stems. The crop is seeded thickly so that the stalks will grow high and slender. The fiber obtained from the hemp is called bast fiber and is of value on account of its length, strength, pliability and general resistance to wear and tear. The system of milling the hemp known as breaking consists in separating the woody portion of the stems from the fiber.

Wisconsin's establishment in the hemp growing business is a story with a rather romantic angle. Uncle Sam appreciated that this hemp industry was tobogganing rapidly toward extinction unless he could eliminate the hand labor difficulties. Twelve years ago the National Department of Agriculture in coöperation with the Wisconsin Agricultural College began growing hemp in Wisconsin, the soils and climate there being admirably adapted for the production of this fiber crop. As soon as it was demonstrated irrefutably that hemp would prove a success in Wisconsin, the authorities exerted every effort toward the perfection of some mechanical device for breaking the crop and reducing hand labor to a minimum. Experienced hemp growers and a large harvesting machinery company coöperated in this work and ultimately appliances were developed which efficiently performed all this work rapidly and at relatively low expense.

In establishing the industry on a practical basis,

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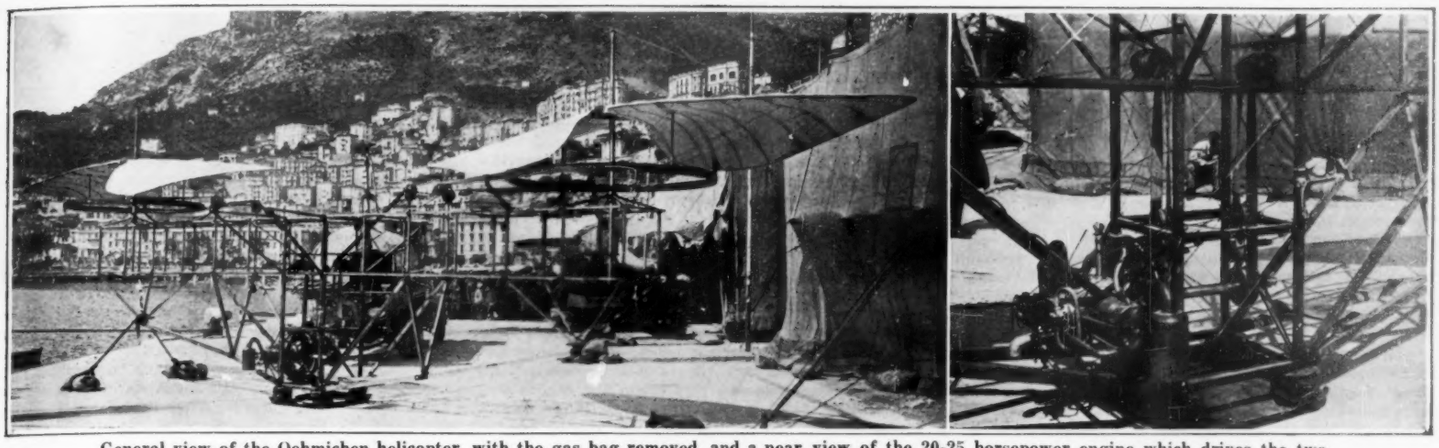
Left: The raw fiber from the Wisconsin mills is sold to large European and American spinning companies which manufacture the finished products. *Right:* Sewing thread, socking twines, wrapping cords, binder twine, and oakum—these are some of the products made from hemp fiber

Scene in a spinning mill handling hemp fiber and some of the finished products



General view of the Oehmichen helicopter, with the gas bag removed, and a near view of the 20-25 horsepower engine which drives the two lifting members by means of belts

Is the Practical Helicopter in Sight?

By George Gaulois

THE helicopter, long held as a classic joke in aeronautical circles, may be coming into its own at last. This does not mean to say that the practical helicopter is already realized, but it does mean to convey the very definite impression that at last the helicopter inventors are getting down to real engineering principles and are developing designs which hold some promise of future success. The day of the toy helicopter with rubber-band motors, intended to represent the merits of a given type of proposed helicopter, is gone. Inventors are now building full-sized machines, equipped with real aviation engines and man-carrying bodies, in order to prove the worthiness of their designs. And in so doing they are rapidly convincing us that there is some hope after all for helicopter flight.

The shortcomings of the airplane have paved the way for the helicopter. First of all, the airplane has to maintain a high rate of speed in order to sustain itself in the air. By the same token it must take off at a high rate of speed, and land at a considerable rate of speed, both of which contain many elements of danger. Then again, the way in which the airplane takes off and lands calls for a large landing space, which makes the airplane impractical for use in cities and over rough country where large fields or clearings are not available. Still further, the airplane, by the very fact that it must keep moving while in the air, is not suitable for military, photographic, observation and other purposes, where the facility to hover is a prime requisite.

All these shortcomings have brought about a demand for an aircraft that can rise vertically, maintain itself at any desired altitude, move in any direction or hover over a given spot and descend in a direct vertical line when the flight is terminated. The helicopter, theoretically at least, seems to contain all the latent elements of such flight.

During the past year or two there have been several serious attempts to evolve successful helicopters. In the United States we have had the experiments of Crocker and Hewitt, which were quite convincing even if they were not pushed beyond the experimental stage. Then there has been the neat little machine evolved by Berliner, son of the well-known telephone and phonograph inventor. In Spain there is the helicopter of Pescara, which is shortly to receive a series of rigid tests by the French army authorities. All these machines, which make use of co-axially mounted screws revolving in opposite direction, have been described in these columns.

We learn from Harry Harper, Technical Secretary of the British Civil Aerial Transport Committee, that remarkable results have been obtained with the helicopter invented by Lieut. Stefan von Petroczy, of the Austrian Army Balloon Corps. In fact, this machine is acknowledged to be the first helicopter in the world which, after making an ascent, has remained for any time hovering in the air at the distance it has risen from the ground. However, the Petroczy machine has not made a free flight, for in every flight it has been controlled by a series of cables paid out by winches on the ground. It has gone straight up under its own power

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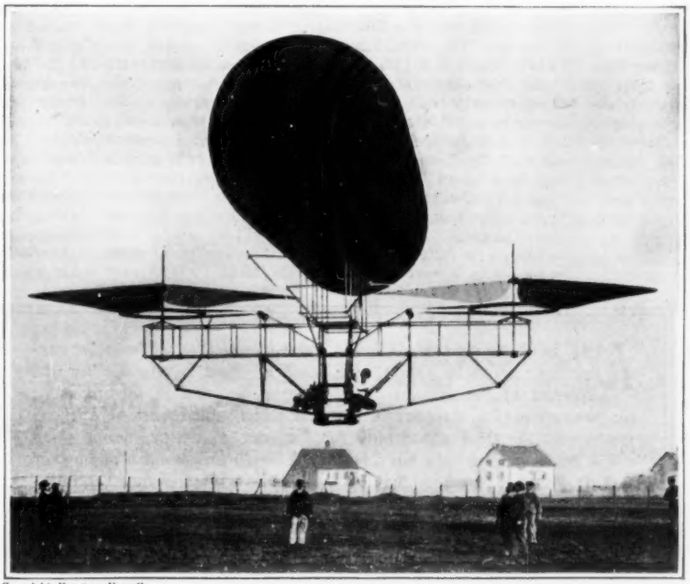

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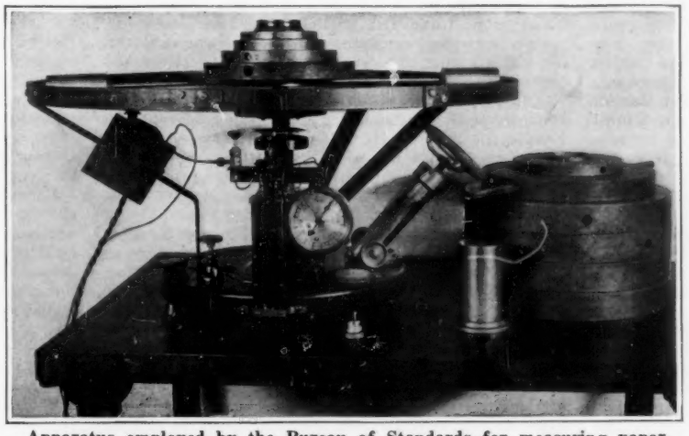
Oehmichen helicopter in flight, said to be the first helicopter to make a free flight, although it is equipped with gas bag

Measuring Vapor Pressures

WHERE accuracy in measuring vapor pressures to a fineness of one part in from three to five thousand divisional units is the desired objective, two types of instruments recently perfected by the United States Bureau of Standards meet the requirements. The two mechanisms, although widely differing in appearance, have much in common, and in functioning in the Government laboratory their uses are well-nigh interchangeable. Each, however, varies in construction and possesses respective merits.

The photograph showing the scaffold-like arrangement is a pictorial embodiment of the new manometer designed by the Bureau of Standards, aiming for accurate measurements up to fifteen atmospheres. It is to be employed extensively as a primary standard with which to calibrate other gages as well as for its limited application as a working unit. The apparatus consists of five V-shaped tubes, 2.5 meters long, mounted on a steel framework and so equipped with valves that any combination of these tubes may be used. The lower half of each of the tubes is filled with mercury while the upper half contains a light liquid (at present alcohol) for the transmission of pressure. The two sawed-off V-shaped tubes shown in the upper left hand corner serve to divorce the alcohol from any gas, the pressure of which is to be determined.

The photograph which presents the revolving mechanism, which might be mistaken for a diminutive "spinning jinny," in reality illustrates a piston gage, built for determining accurate measurements of pressures up to 100 atmospheres. It is easier to operate than the manometer just described, and the scientist lends himself to the negotiation of this apparatus as preferable to the former in making actual pressure measurements. It consists of a steel piston snugly fitted within a steel cylinder. The pressure, transmitted by oil from a short mercury manometer mounted on the base of the gage, acts against the base of the piston and exerts an upward force upon it. This exertion is balanced by piling the weights, shown in the right of the illustration, upon a steel column which extends up from the piston. During the pressure measurement the piston is continually rotated to prevent it from sticking. A small dial gage indicates the approximate pressure, and aids the operator in balancing the piston gage. Like the manometer, extreme accuracy is a positive virtue of the piston gage—being exact to the fineness of one part in from three to five thousand integral parts.



Apparatus employed by the Bureau of Standards for measuring vapor pressures to a fineness of one part in from three to five thousand

Ostrich Skin Shoes

WE have recently had many odd leathers such as shark skin, porpoise, etc., and now the ostrich comes forward to help leather shortage. Shoes made of leather from ostrich skins will outlast leather. The ostrich always had a reputation of being a tough old bird.

Reorganizing Our Government Machinery—II

Some Concrete Reasons Why Rearrangement for Mere Rearrangement's Sake May Not Be a Good Thing

By C. H. Claudy

WHEN the machinery in a factory becomes worn out, it is replaced. If out of order, it is repaired. If out of date, it is scrapped and a new and better engine put in its place.

Our government machinery is both out of order and out of date. It is badly in need of repair and replacement. It is uneconomical, inefficient, clumsy, and duplicates itself in many parts. It should therefore, be repaired, where repairs are possible, and scrapped and replaced where nothing short of scrapping and replacement is possible.

As to how this is to be done there is a wide difference of opinion. Unfortunately, those in authority are not governmental mechanics. Congress, composed of many good men and true, able and conscientious, is not made up of experts in running government machinery. As a consequence, some of the remedies proposed are ineffective, some are weak, and some are vicious. Some, if carried out, would do more harm than good.

In repairing mechanism with a monkey wrench it is common sense not to throw the monkey wrench into the gears. A watch which won't keep time cannot be made accurate by taking it apart and putting it together again with the same wheels in different places. A reorganization of the government which merely rearranges existing parts, will not accomplish much. What we want is not a shuffling of parts, nor even a replacing of some with other similar parts, but reorganization which will eliminate unnecessary duplication and waste of effort, money and time.

Reorganization of our scientific work as well as of other parts of the government is a vital, pressing necessity. But our scientific activities are too important to be man-handled in ignorance, and too vital to our welfare to be tampered with without great consideration.

The most common idea in regard to reorganization is that it should group related activities under one head in order to avoid waste. The government supports a large number of chemical, physical, electrical and other laboratories. "Why not," asks the legislator, "create a 'scientific bureau' which should control *all* these activities, allocate personnel, do the purchasing, and direct all the chemical, physical and electrical work of the government?"

In such a proposition lies a grave danger. Any allocation of any government scientific work to any department, made without a most careful consideration of *all* the factors which enter into the question may be dangerous. Scientific activities are *not* similar functions because similar in nature. The Bureau of Mines makes researches into poisonous gases and gas masks. Chemical Warfare, in the Army, does exactly the same thing. But the kinds of gases, the kinds of masks and the purposes of the two investigations are totally different. To say that the two should become one, that the Army should do the mine work or the Bureau of Mines the Army work, is an absurdity.

Much of our government machinery, like Topsy, "just growed." The spectacle of the Treasury saving lives of wrecked sailors, attending to prohibition and looking after the public health is matched by the picture our lawgivers painted when they put the Weather Bureau and Bureau of Public Roads under the Agricultural Department. The legislator interested in economy sees this and asks "if the Coast and Geodetic Survey belongs under the Department of Commerce, why does the Geological Survey belong under the Interior Department? Both do surveying."

True enough, yet commerce is carried on in ships, and ships need charts of our coasts, whereas the Geological Survey, interested in map making of the interior, has no function to perform as regards navigation.

There is a tremendous overlapping of government scientific activities. Much of it must be eliminated, but if in eliminating the duplication we also eliminate what we created scientific bureaus for—the gaining of knowledge—we shall do more harm than good.

Let us take a single scientific activity at random and follow it through our government machine. Engineering research is a comprehensive subject which means much to us as a nation. We are the world's premier builders and constructors. We put up the biggest and tallest buildings, our elevators run faster and more safely than others, our trains cover more track, our concrete roads are better, our hydraulic labors are world models. All these and a thousand similar activities are the result of engineering research. Some of that research has been done in government laboratories.

The War Department does engineering research in the United States Engineering Office, in the Mississippi River Commission and in the California Debris Commission. In the Treasury Department the Supervising Architect has some to do, as does the Public Health Service. Yards and Docks and Engineering in the Navy Department, of course, make independent engineering researches and the Interior Department has engineering laboratories in the Bureau of Mines, Reclamation, Geological Survey, the Alaskan Engineering Commission and the Division of Capitol Building and Grounds. The Weather Bureau, Public Roads and Forest Service in the Agricultural Department; the Bureau of Standards, the Bureau of Lighthouses, the Coast Survey and the Bureau of Navigation in the Department of Commerce—all have their engineering offices and laboratories and four of the independent units of the Government (not attached to or a part of any department) have similar activities: the Interstate Commerce Commission, the International Joint Boundary Commission, the Shipping Board and the Panama Canal Board.

Twenty-two different offices and bureaus then, make engineering researches for Uncle Sam. "Horrible," says the efficient Congressman. "Let us create an 'Engineering Research Bureau' and transfer *all* these activities to it."

But the sort of engineering research which is done by Yards and Docks would have no relation to that in which Reclamation is engaged. Boundary work engineering involves the channels of rivers and the shores of lakes; so does the engineering done by the War Department's Board of Engineers for Rivers and Harbors. But the latter is done with an eye to efficiency; doing public work with publicly paid army engineers, giving them practice against the need of war engineering and allowing them so to labor that our rivers and harbors may be available as means for defense. Are you, Mr. Legislator, going to take this from their hands and give it to the Boundary Commission, or will you involve the Army in boundary disputes?

The question is not so easily settled after all. A mere listing of similar activities does not prove them nearly enough related to demand unit control. Because the same thing is produced by two different agencies of the government is no real reason for combining these agencies. Twenty-four different offices in the government do surveying, or mapping or charting, or all three. Many of them could be combined in one office, to the betterment of the making of the maps and charts and a reduction in cost. But it is unthinkable that *all* of them could. The three largest map-making establishments of the Government are the Coast and Geodetic, the Geological Survey and the Hydraulic Office of the Navy. If they were *all* combined in one grand chart-making establishment the initial cost of making charts would be reduced. But the efficiency of chart using would also be reduced. A civilian production is rarely as good for a military purpose as the same thing produced by military authorities. The Navy has found it essential to its efficiency to make its own guns, its own sea-planes, its own officers, its own yards and docks, its own ammunition. Why should it be supposed that the Navy would not find the ends of efficiency best served by making its own charts?

"All right, then," says the economy hunting Congressman, "we'll make a great chart bureau and put it all under the Navy. How will that suit?"

It won't suit. What does the Navy know about Geological research? What does the Navy know about the needs of the Land Office? What tie is there between the Navy and Reclamation? None.

The principle on which too many organizers of the Government are working, is that the end to be served is purely one of economy. It is not. Although the American people are anxious that their government engine shall be run economically, they are also desirous to get value received for its running. It is when it is *both* expensive and inefficient that we kick. Reorganization will fail if efficiency of *use* of a government product is not obtained. Economy of operation which destroys efficiency of use, will injure us far more than we will benefit by the saving of a few dollars of appropriation.

An instance to the point is the proposal to take the Naval Observatory from the Navy and put it under the Department of Commerce. The theory, apparently, is that one of the great functions of the Observatory is the provision of standard, accurate time; that time, belonging to us all, is the basis of all commerce; that, therefore, the agency providing it should be under the Department of Commerce. On the same theory, powder for guns, a product of mines, should be produced by the Bureau of Mines, and sextants, being instruments of precision, should be produced for the Navy by the Bureau of Standards.

The Naval Observatory, even if under Commerce, would still have to depend upon the Navy to send out radio time signals, and it is probable that the Navy would immediately find funds somewhere for the equipment of a new observatory of its own (if this one were taken away from it) to be able to be responsible for its own Nautical Almanac, on the accuracy of which depends thousands of lives and millions of dollars of Naval property.

Another instance is found in the subject of education. Education is a government function, and educational work a vast activity of the United States Government. Fifteen separate agencies of the Government do educational work. "Combine them!" cries the economist. "Get them all together and let them teach mightily, because united, instead of weakly, as they must do while separated."

Undoubtedly the Government should have a Board of Education. Some believe it should be a department with a cabinet officer at the head. Undoubtedly it could, and should, look after educational matters which are educational first, and of special effect afterward. But to take the agricultural education of farmers out of the hands of the Agricultural Department, or the education of Army and Navy officers out of the hands of the Army and Navy, or the promulgation of the principles of hygiene out of the hands of the Public Health Service, would be a stultification of purpose for the sake of economics of purse. This is never economy in the long run.

Enough has been said to indicate the general trend of objection to a wholesale reorganization of the Government on a plan which contemplates putting similar activities together under similar control for the *one* reason that they *are* similar and on the theory that the similarity affords an opportunity for economy of appropriation and administration regardless of the economy of the results.

If the objection is well taken and sustained by common sense, then *the only possible principle upon which a successful reorganization can be effected is that already outlined: the economy of the use of the product combined with the economy of its manufacture or administration.*

LAST week we gave Mr. Claudy space in which to set forth the conviction, which he shares with most of those responsible for the conduct of the Bureaus and Departments, that in the necessary reorganization of Governmental agencies which will sooner or later be made, there is great opportunity for Congress to do the wrong thing if not wisely guided. In this issue Mr. Claudy brings out a number of specific instances to show that the scheme of grouping together indiscriminately all agencies doing similar work is not necessarily sound in every case. In many cases it is sound, and much of the consolidation of this character that is discussed should be effected. But every case should be decided upon its merits, as Mr. Claudy so clearly brings out; and the Navy, for example, should not be robbed of one of its essential branches just because somewhere else in Washington similar work is being done with another end in view.—THE EDITOR.

A New Era In Wireless

What Is Being Done With the Radio Telephone By Way of Broadcasting News, Music and Sermons

By L. H. Rosenberg

FOR years commercial stations have been using the wireless telegraph successfully and amateurs, experimenting with the art, have spent hour after hour on this interesting subject. The mystery of the dots and dashes received from the ether after having traveled hundreds of miles, has interested thousands, and many boys and even grown men have painstakingly spent hours in order to master the wonders of radio and to learn perfectly how to send and receive code messages.

But now there is a new era, and we have radio in a new rôle. No longer is this fascinating subject confined to the expert, for today all may enjoy its many benefits. Radio telephony has developed to such an extent that one does not need to be an expert to receive the messages of the air.

From many plants all over the United States music and actual talking can be picked up as broadcast from efficient broadcasting radio telephone stations. One of the most successful of these stations is the experimental broadcasting station of the Westinghouse Electric and Manufacturing Company at East Pittsburgh, Pa. Concerts are given nightly from this station and they are heard over an area of three million square miles. In this territory there are hundreds of thousands of persons who hear these concerts. The programs for the evenings usually consist, in the main, of phonograph music and national and international news. The great success of this scheme which is attracting wide attention, is the care taken in the selection of the program. For instance, a careful study has been made of phonograph music. Records which sound exceedingly well when played on the ordinary talking machine may be entirely unsuited for this character of music. The best records are tenor and contralto solos and it has been found that instrumental music such as the xylophone, saxophone, the accordion and the cornet are very clear. The program for each night is carefully considered and a selection is made of instrumental and vocal, classical and popular.

Not only is phonograph music transmitted from this station, but the sending out of a complete church service is the feature of each Sunday night. In the church and pulpit of the Calvary Episcopal Church of Pittsburgh are installed several transmitters. These transmitters are connected to a private telephone line which runs to the radio station seven miles from the church. When the choir sings, or the rector preaches, these transmitters respond to the sound waves and the music or sermon, as it may be, is transmitted to East Pittsburgh via the telephone line. There it is broadcast by means of the radio apparatus, thus allowing thousands of people to hear the service in their own homes. Think what this means to many people: the invalid, unable to go to church can enjoy its benefits without leaving his bed or wheel chair; the farmer, too far from town to go to church has the service brought to him; and the sick in the hospital are encouraged to get well by the wonderful words of the preacher. It is marvelous, this transmitting of church services by radio. One can almost imagine being in church. The blending music of the sixty men and boys lifted in song and the ring of the deep-set voice of the preacher all make the service seem realistic.

So many of the innovations with radio have proved successful that the possibilities of the radio broadcasting plan seem unlimited. When Herbert Hoover visited Pittsburgh to tell his story about the starving children in Europe, arrangements were made for sending this appeal broadcast by radio. A special speech was not necessary. Immediately in front of Mr. Hoover at the dinner, held at the Duquesne Club, was a transmitter. It was arranged in such a manner that it was unseen by both Mr. Hoover and the audience but this did not prevent it from working perfectly. Instead of making his plea to one or two hundred men gathered at dinner, Mr. Hoover was able to reach thousands of people who stayed at home listening to their wireless receiving sets.

A short time ago Prof. Vladmir Karapetoff, professor of Electrical Engineering at Cornell University, who is also a noted musician, gave a lecture piano recital at the Westinghouse Club. Although this event was held in a large hall, the attendance was limited. Here was wonderful music and a discussion of the great composers, which were limited to hundreds—that is it would have been limited to hundreds if it had not been for the wonder of radio broadcasting.

Besides the transmission of the concert music, the church service, the speech of prominent men, broadcasting of a more material nature is forthcoming. The farmer can receive the crop report at the present time; this is sent from Washington, D. C., and the tired business man can get the high points of the latest news. When he gets his morning paper, if he lives in the city he reads more about the happenings given in brief the previous night by radio.

And let us predict further. When the radio broadcasting has reached a higher stage of development and is more fully utilized, the benefits will be enormous. It will be like a three-ring circus. If you look in one direction, you see clowns performing antics, or you may see acrobats, chariot races and what-not.

Soon in radio you will be able to get popular music if you desire, or classical music, or church service, or speeches, or crop reports or news. These will all be sent out at the same time and it will merely be a question of "looking in the proper direction" for the reception of your choice. This will be accomplished by transmitting in what is known as "wave lengths."

One wave length will convey one kind of entertainment, and another wave length will convey another kind. By a simple adjustment of the receiving apparatus, any wave length reception may be selected.

The apparatus necessary to receive this radio broadcasting is exceedingly simple and can be purchased from a few dollars up, depending on the quality of reception desired and the distance from the broadcasting station.

The original idea of the necessity of the telephone headset has been bettered and now by the addition of a loud-speaking horn to a good set of apparatus, many can hear the broadcasting from the same outfit.

Although much has been done with respect to these radio telephone experiments, in a few years we will wonder that we were ever able to exist without enjoying its many benefits.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

That Non-Skid Horseshoe Prize

To the Editor of the SCIENTIFIC AMERICAN:

In your paper for March 19, 1921, you published a communication from George Foster Howell, on page 227 of the SCIENTIFIC AMERICAN, showing that our Association is offering $500 for the most satisfactory non-slip horseshoe or device. Mr. Howell writes me that he distinctly wrote $1,000. It strikes me that if you could manage to give the space it would be well to give the following details of the competition:

1. The competition is open to all without restriction.
2. The Association reserves the right to reject any or all designs submitted and to make final decision on award.
3. A committee of three, appointed by the President of The American Humane Association, composed of one prominent veterinarian and two practical horsemen, of large experience, will examine the designs submitted and report on the same with recommendations to the Association.
4. The design may be submitted by means of drawings or a model, or both. A description should accompany each design submitted, stating in detail the merits claimed for the invention, the materials used or proposed to be used in its construction, and its estimated cost. State whether or not the invention is in actual use or has been tested, and the results as to wearing record, non-slipping qualities, and other advantages. Such descriptive matter should be typewritten.
5. Each sheet of drawing and each model and all descriptive matter shall be unsigned, but shall bear a device, number or motto for identification; and the same device, number or motto shall be placed on a sealed envelope containing the competitor's name and address. This will not be opened until the award has been made. In making the award, the cost of the device, its wearing qualities, and all other points of merit will be taken into consideration, in addition to its non-slipping qualities.
6. Drawings and models with the accompanying envelopes must be securely packed or wrapped and delivered at the office of The American Society for the Prevention of Cruelty to Animals, Madison Ave. and 26th St., New York, before 6 o'clock P. M., July 1, 1921.

All inquiries regarding this competition should be addressed to

DR. WILLIAM O. STILLMAN,
President The American Humane Association, 287 State St., Albany, N. Y.

How Does a Cat See in the Dark?

To the Editor of the SCIENTIFIC AMERICAN:

I noticed the other evening in a fairly well lit up room a cat sitting near the door waiting for it to be opened so that she could go out. There was nothing in particular about the door to see or for the cat to concentrate her mind on except merely to want to get out, so that she could not have experienced any eye strain. A cat's eyes, in good light, are of a yellowish color. This particular cat appeared to have black eyes, and that is how I came to notice her in particular.

Observing a little closer, I noticed that the darkness of color in her eyes was due to a complete opening of the iris diaphragm. In a cat's eye the diaphragm opens more than in eyes of some other animals, including the human eye, so that I would judge in the language of photo-optics that the aperture in the eye of this particular cat was approximately F-1.

I am certain that the diaphragm aperture in the eye of the average man would, under the same conditions of illumination, be approximately F-4. Inasmuch as the amount of light that entered the cat's eyes would therefore be sixteen times more than would have entered the man's eyes, it probably indicates a retina sixteen times less sensitive. If this is so, how can her catship see in the dark where a man cannot. It may be said that a cat's eyes are more sensitive to perhaps the infra-red rays, or perhaps she sees by them altogether. This, however, appears doubtful, for the reason that artificial illumination is particularly rich in these infra-red rays in which the cat found it necessary to absorb much more light than a man would. This cat further proved that if she opened her diaphragm to full capacity under such good light she must have had little or no further resources in a comparatively dim light, and therefore, could not see nearly so well as a man could in a similar dim artificial light.

Under the circumstances above described the cat must have seen objects also much wanting in focal definition.

A. F. SHORE.

New York.

Electromagnetic Waves in a Moving Magnetic Field

To the Editor of the SCIENTIFIC AMERICAN:

Gilbert showed that the earth is a great magnet, Faraday that every magnet is surrounded by a "field of force." As the earth is a "body in space" and is known to have a magnetic field it seems reasonable to suppose that the other bodies in space have such fields. Eclipse observations indicate that this is true for the sun. When Maxwell proved that light was an electromagnetic phenomenon I thought a moving magnetic field should affect it, that light in passing among the bodies in space would not move in straight lines on account of their magnetic fields. To test the theory a special form of interferometer was designed and ordered from Gaertner of Chicago. It divided a beam of light into two paths at right angles. In one path a powerful rapidly revolving magnet was placed. As the light was affected the results were published years ago in *The American Journal of Science*. As recent eclipse observations appeared to show that light was affected in passing near the sun, Einstein's theory that the effect is caused by the attraction of the sun's gravitational field is receiving much attention from your readers. It is therefore desirable to bring my forgotten theory and experiments to their attention, for some, at least, of the observed deflection is due to the sun's magnetic field.

WILLIAM ROLLINS.

Boston, Mass.

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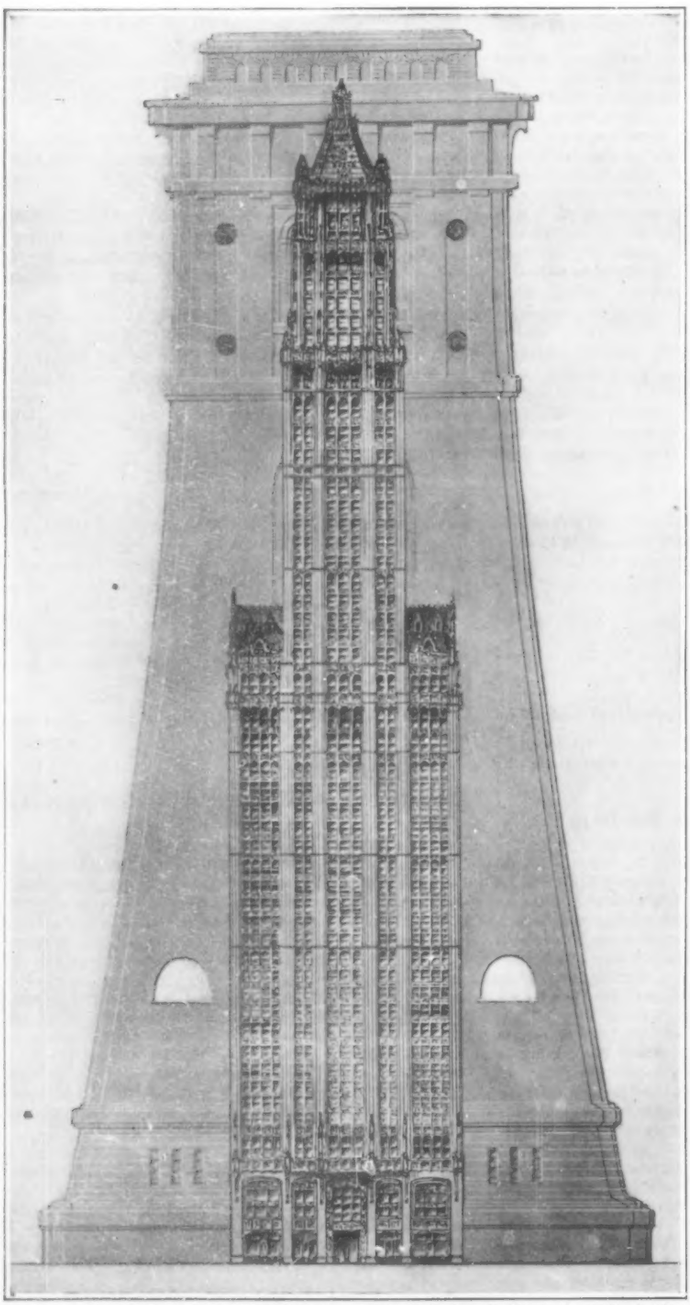
Hudson River Bridge, drawn to scale, imposed upon the skyline of New York. If one anchorage were placed at the Battery, the other woul



The Woolworth Building, 151½ feet by 792 feet, looks slight against the bridge tower, 400 feet wide by 840 feet in height

A Study in Mag

Comparison of the Hudson River Bridge Largest Constructions in Engineeri

By J. Bernard Wal

COMMENTING in a recent issue upon the unprecedented magnitude of the Hudson River Bridge, we stated that it was not idealism or any striving after the spectacular that led to the conception of this bridge upon such a gigantic scale. We showed, on the contrary, that its dimensions have been determined by the severest application of the principles of economy, since in all constructive engineering work it has been proved, particularly in recent years, that there is economy in concentration. It is because of the reduction both of the first cost and of the cost of operation, which will be secured by carrying the transportation between the Western continent and Manhattan Island on a single bridge, that the Hudson River structure has been planned upon its present stupendous scale.

The main outlines of the bridge, as at present determined, call for a total length from anchorage to anchorage of 6,660 feet, divided into two shore spans each 1,710 feet long, and a central span across the river of 3,240 feet. Including anchorages the length is 7,460 feet. The roadway, 220 feet in width, will be suspended from four steel chain cables, each consisting of 80 lines of eyebars arranged in three banks and enclosed in a watertight tubular casing of bronze plating, whose diameter will be fifteen feet. The upper deck will consist of a broad automobile and motor-truck roadway 155 feet in the clear, and there will also be provision for two trolley line tracks and two 17-foot walks for passengers. On the lower deck will be ten trunk railroad tracks.

The Bridge and New York's Skyline

We have heard a great deal lately about relativity, and in the endeavor to convey a quick impression of the great height and length of the Hudson River Bridge we have selected the skyline of lower Manhattan, from above Grand Street to the Battery, as a basis of comparison. The view at the top of this page represents the skyline, as it would appear if drawn to exact scale without any foreshortening by perspective. The heights and widths of the various buildings are also drawn to scale; and upon this drawing we have imposed the big bridge, drawn to the same scale and placed in the same vertical plane. We confess that the result is surprising. If one anchorage of the bridge were built at Battery Place abreast of the Customs House, the first tower would be abreast of the Singer Building, the second tower just to the north of the New York Life Insurance Company Building, and the other anchorage would cover half of the block to the north of Grand Street, the total length, including anchorages, being 7,460 feet. In a comparison of vertical height we find that the anchorage at Battery Place, 500 feet in height, would overtop the Whitehall Building by 84 feet, and that it would be exceeded in height only by the Bankers' Trust Building, 540 feet, the Equitable Building, 537 feet, the Singer Building, 612 feet, and the Municipal Building tower, 580 feet. The two main towers, each 840 feet in height, would have a margin of about 50 feet over the Woolworth Building, whose extreme height to the top of the finial is 792 feet. Many of us remember the time when the dome of the World Building stood higher above the street level than any other structure in New York. Yet today the upper cable of the bridge at its lowest point in the main span would stand about level with the top of this dome.

The End Anchorages

The function of a suspension bridge anchorage is to resist the horizontal pull of the cables. This, in the Hudson River Bridge, amounts to 260,000 tons. Resistance to this pull wi
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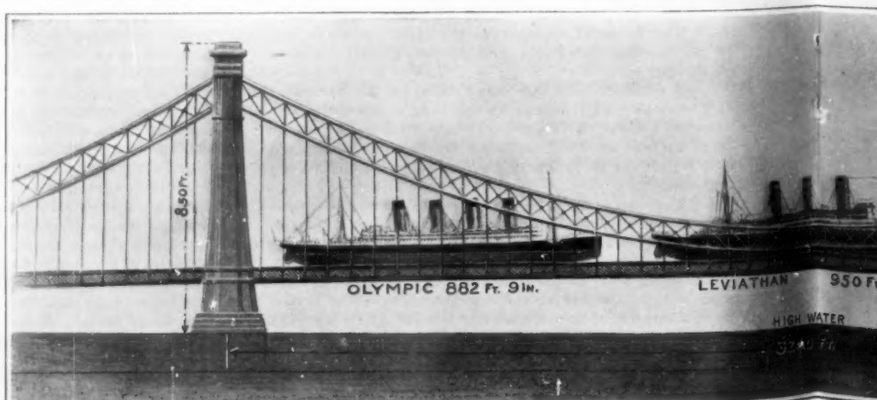
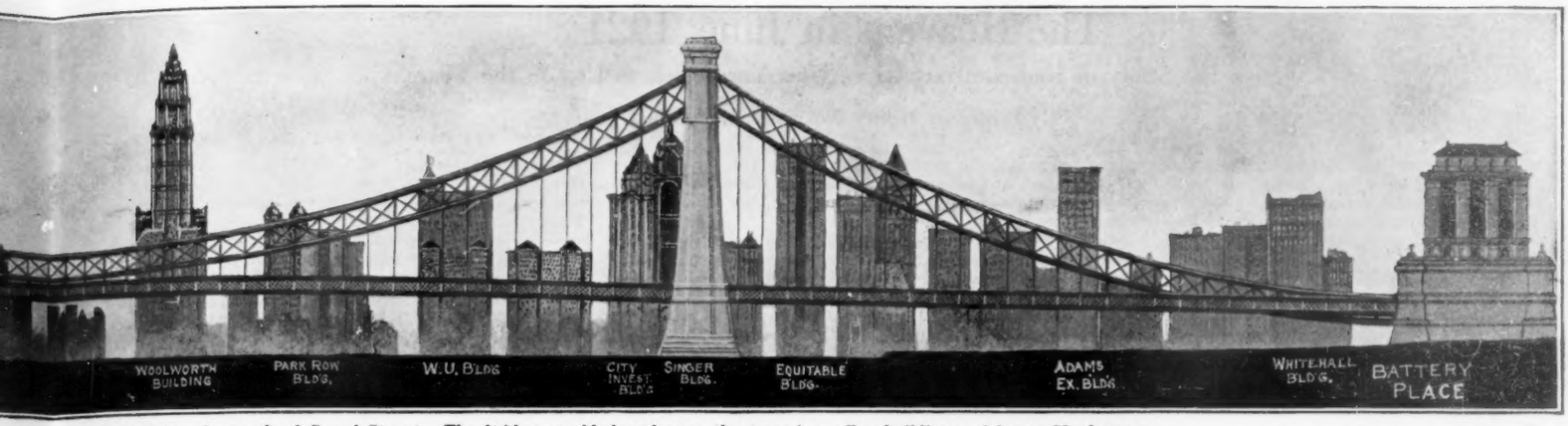


The main span, 3240 feet in length, could accommodate three of the world's largest steamships, with 4
far short of the weight of the



r, the other would stand to the north of Grand Street. The bridge would dwarf even the towering office buildings of lower Manhattan

in Magnitude

River Bridge with Some of the World's in Engineering and Architecture

By Bernard Walker

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pull with a wide margin to spare, is obtained by building the anchorage of such size and weight that the frictional resistance to movement between itself and the ground is sufficient to hold the cables taut and do so with a sufficient friction in reserve to prevent the slightest movement. The engineers' calculations call for a mass of masonry measuring on its base 400 feet in the direction of the length of the bridge, 375 feet in width, and 220 feet in height, while upon this base will stand two office buildings 70 feet in width, 250 feet in length and 280 feet in height. Looking along the axis of the bridge, there will be a space of 100 feet between the inner faces of these buildings. On the two anchorages there will thus be four modern office buildings, which will contribute considerably to the annual receipts from the bridge.

The Main Towers

In order to secure sufficient height to give the chain cables the proper curve or catenary and also to secure a well-balanced architectural effect, it was found necessary to carry the main towers up to a full finished height of 840 feet. Also, to secure sufficient breadth to give stability, it was necessary to make the base of the towers 200 feet in depth by 400 feet in width. From this base the towers rise with a very pleasing curve to the summit, where they measure 100 feet in length by 200 feet in width. It should be understood that the structural part of the towers, which carries the load of the cables, is not visible. Externally the towers are of granite; but this stonework is merely a covering for the internal, very massive and strongly braced steel towers which carry the load of the cables. The external masonry walls were adopted, partly for their architectural effect, but principally to act as a protection for the internal steelwork. This protection will be so complete that one painting of the towers will be good for a period of at least a decade.

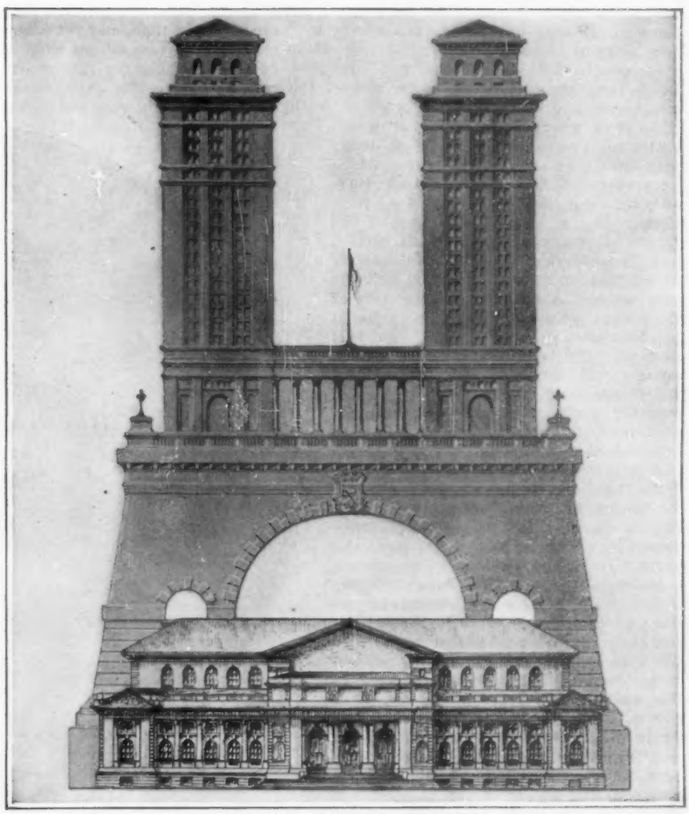
At a height of 170 feet above ground level, the tower will be pierced by three arches, a central arch 150 feet wide and 100 feet high, and two side arches each 30 feet in width. In the center of the face of the tower will be a round arch window 120 feet in width and 275 feet in height. Its framework will be of steel, and it will be filled in with heavy wired glass. The purpose of the windows is to light the interior; also, of course, they add to the architectural effect by breaking up the vast blank front of the tower. The total weight of steel in each tower will be 35,000 tons.

In order to give an adequate impression of the great height and bulk of the Hudson River Bridge towers, we have shown one in elevation, and upon it our artist has drawn to exact scale the front facade of the Woolworth Building. The illustration speaks for itself.

The Floor of the Bridge

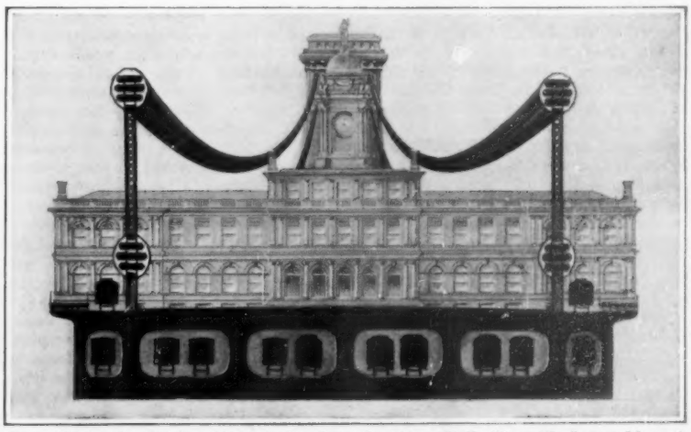
On an equal scale of magnitude with the rest of this great structure is the double-deck, suspended floor of the bridge. On the upper deck, on the extreme outside, will be two 17-foot passenger footways. Adjoining these will be two tracks for trolley cars. Between the cables will be found one of the greatest boulevards in the world—a clear, unobstructed roadway 155 feet in width and 12,000 feet in length, if we include the approaches. Entrance to this roadway commences near Ninth Avenue, New York. The anchorage will be pierced by three arches, one central arch 150 feet wide by 100 feet high, and two 30-foot side arches. The roadway will be covered with asphalted concrete. It will be absolutely watertight, and its broad surface will

(*Continued on page 459*)



An anchorage compared with 42nd St. Public Library. Width, 375 feet; depth 400 feet; height to top of office buildings, 500 feet

steamships, with 400 feet to spare. Although their combined weight is 160,000 tons, it would fall the weight of the main span



So wide is the bridge (220 feet) that the City Hall, New York, could rest upon its upper deck, with a few feet to spare

The Heavens in June, 1921

How the Study of Radioactivity Gives Us a Yard-Stick to Use on the Years

By Professor Henry Norris Russell, Ph.D.

IT has long been realized by all students of nature that the duration of the universe in time, like its extent in space, must be exceedingly great. But when it comes to attempts at measurement, it is a far harder matter to deal with time than with space. The simple and powerful geometrical methods for the measurement of great distances have no analogues when it comes to great intervals of time; and thus, though we can determine, with fair precision the distances of extremely remote stars, it is still by no means easy to estimate the age even of the planet on which we live.

Some Geological Dicta

Some idea of the age of the earth can be got, of course, from geological evidence. To wear away the mountains, and carry their debris into the sea to form new sedimentary strata, must have taken millions of years at the very least; but when we try to figure out how many millions, we have great troubles in making even rough estimates of the total quantity of material that has been worn away, and of the rate of weathering and erosion. What is worse, we have very little idea whether the rates at which geological processes are going on today are similar to the average rates which have prevailed throughout geologic time, or whether present conditions are exceptional. It can be calculated that, if the rivers of the earth had always carried into the sea every year the same number of millions of tons of dissolved salts as they do now, the whole existing salt of the oceans would have been accumulated in about seventy million years. But this is a big "if;" and some able geologists, notably the late Professor Barrell of Yale, believe that the present rate of transfer of the salt to the sea is unusually rapid, and that the age of the earth is therefore greater than the figure named.

Lord Kelvin calculated many years ago, from the internal heat of the earth and the known conductivity of rocks for heat, that it could not have been more than twenty or thirty million years since the earth was red hot out to the very surface—otherwise it would have cooled off more at a depth of a mile than it actually has done. But this calculation assumed that the earth was losing heat at its surface while no heat at all was being produced in the interior. This was the only assumption that seemed reasonable when Lord Kelvin wrote; but since then radioactivity has been discovered, and it is known that the radium in the rocks of the earth's crust (with the parent uranium which keeps up the supply of the shorter-lived radium) is steadily generating enough heat to account for all that is lost by conduction to the surface, and that it will continue to do so for billions of years. So the argument from cooling falls out altogether and the problem must be attacked afresh.

The theory of radioactivity has at last, however, furnished us with a real foothold for our estimates of great intervals of time. We know that the heaviest atoms, such as that of uranium, are slightly unstable. A certain proportion of them break up every year, expelling an alpha particle with enormous speed—which ultimately contributes enough energy to heat the surroundings—while the residue of the atom settles down into an atom of a new kind. These new atoms again undergo similar changes, and so on through a long series of processes—radium being only one member of this family. When a steady state has been attained, each of these intermediate substances occurs in a definite proportion—the supply being kept up by the disintegration of the next preceding member of the list exactly as fast as it is depleted by the breaking up of the substance being itself considered. The more rapidly changing substances will evidently be present in smaller proportions. Now it is found by direct analysis that the quantity of uranium in a mineral is always about 3,100,000 times as great as the quantity of radium. It follows that the percentage of radium atoms that break up every year is 3,100,000 times as great as the corresponding percentage for uranium atoms, and hence that the average life of an atom of uranium is three million times as long as that of a radium atom.

Now the latter can be found by direct investigation of various kinds, and it is known that the "half-period" of radium is a little over 1,600 years. That is, if we have today any given quantity of radium, at the end of 1,600 years half of its atoms will have been disintegrated, and only half the radium will be left. After another 1,600 years half this remnant will have vanished, and so on indefinitely. The corresponding "half-period" for uranium is 3,100,000 times as long, or nearly five billion years.

The Age of the Earth's Crust

Here at last we have got hold of a process that is slow enough to serve as a measure of great intervals of time, and yet such that, by the fortunate possibility of comparison with radium, we know with decent accuracy the rate at which the slow process takes place. As a first example of its utility, we may take the age of minerals and rocks. After the long set of changes, the uranium-radium series settles down into an apparently stable type of atoms, with the properties of lead. It is not ordinary lead, though; for while its chemical properties are the same its atomic weight is different—206 instead of 207—and careful analysis will detect the distinction. Suppose now that we set aside a quantity of uranium (or some of its compounds) enclosed so that nothing could escape or be added to it. After 80 million years, a little more than one per cent of the uranium would have "decayed" and the disintegrated atoms, after running through their changes, would have settled down as lead—losing a little weight on account of the particles shot out from them during the changes. If after this time we could make an analysis of the material, originally chemically pure, we should find just one per cent as much lead as uranium in it. The lapse of another eighty million years would find the lead increased to nearly two per cent of the uranium; and so on.

Now we cannot wait these millions of years to watch our experiments; but nature has kindly started similar experiments for us, by forming crystals of minerals, rich in uranium, in rocks of great geologic age. All through the ages since they were formed the uranium in these crystals has been decaying, and lead has been forming; and from an analysis we can work out how long the crystal has been there, sealed in the rock. The values so obtained for the ages of various rocks agree in general with the geological record, rocks geologically young showing little lead in proportion to the uranium. Much careful work has been done on this line by various investigators. What interests us most at the moment is the age of the oldest minerals. Specimens from various countries in Europe, Africa and America have been found which appear to be between 1,000,000,000 and 1,200,000,000 years old. They are all from rocks of great geological antiquity (Middle Pre-Cambrian), but according to Professor Barrell, who collected these data, they are probably far from representing the original material of the earth's crust (if indeed any such remains). The evidence therefore appears to be convincing that this world of ours is at least a billion years old.

The Upper Limit

But how much older than this may it be? Can we set any limit at the other end, and say that the earth is younger than this figure?

The present writer has recently made an attempt, based upon another assumption of radioactivity. Joly, the Irish physicist, has shown from analysis of many rocks, made by the exceedingly delicate methods which detect radioactive substances, that, on the average, the proportion of radium in these rocks is about one part in 400 billions, by weight. To keep this radium there there must be fully three million times as much uranium, or seven parts of uranium per million parts of rock.

Now this uranium is steadily disintegrating, and so far as is known to science there is no way in which uranium atoms are being formed. There is no heavier known element to break up and form them. Hence the present quantity of uranium must be only the shrunken remnant of a greater quantity which was once present. Five billion years ago there must have been twice as much; ten billion years ago twice that, or four times the present amount and so we go, doubling every time, until we find a thousand times the present amount 50 billion years ago, and 85 billion years ago come by calculation upon a world made entirely of uranium.

But we must not push our reasoning so far. The uranium which was once there and has changed has doubtless changed into lead. From the amount of lead now present we can figure out the amount of radium originally needed to produce it. According to Clarke, of the U. S. Geological Survey, the average proportion of lead in ordinary rocks is twenty-two parts per million. This corresponds to 25 parts of uranium originally present. Add the seven parts which are still there, and we have an original content of 32 parts of uranium per million, which has died down to a little less than one quarter its initial amount. The time necessary for this is eleven billion years.

But this is too high an estimate, for all the existing lead cannot have been produced by the decay of uranium—the atomic weight is different. We must allow, too, for the fact that there is thorium in the rocks—another radioactive element, which also decays ultimately into a different sort of lead, with an atomic weight of 208. Making allowance for the thorium (now 30 parts per million according to Joly) we find that the existing lead could have been produced by the uranium and thorium combined in eight billion years. The mixture of the two kinds of lead would give an average of about the right atomic weight for "ordinary" lead. But of course we cannot be sure that all the "ordinary" lead originated in this way. If it did not, our estimate is too high—but that is the proper direction for error to take in computing an upper limit.

However this may be, we face a very interesting situation. Calculations based on well-known principles

(*Continued on page 459*)

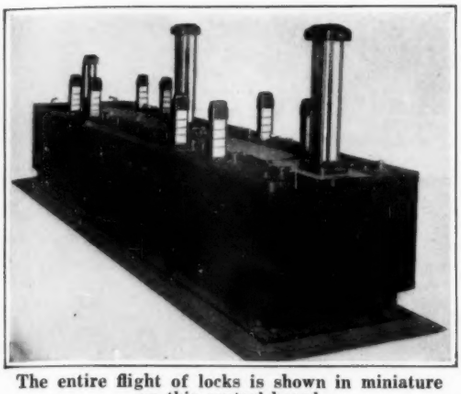
At 11 o'clock: June 7.
At 10½ o'clock: June 14.
At 10 o'clock: June 22.

At 9 o'clock: July 7.
At 8½ o'clock: July 14
At 8 o'clock: July 22.

At 9½ o'clock: June 30.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on June 7, etc.

NIGHT SKY: JUNE AND JULY



The entire flight of locks is shown in miniature on this control board

The Canal Lock Switchboard

FOR controlling the locks of the six-mile industrial canal being built for the Port Commission of New Orleans, a small electrically operated miniature canal switchboard has just been perfected. Quite out of sight of the canal itself, one man as operator can control the movements of the lock machinery and have before his eyes just what is happening on the actual canal when he turns the control handles.

The miniature canal, or control board, is 16½ feet in length, and is rated at 110-220 volts. In solving the problem of lock control, the engineers so designed the switchboard as to show in miniature the actual operation of all main apparatus; also to indicate the level of water in the lock chambers and the position of all water valves.

The switchboard shows the lock chambers of the canal by a stretch of marble slabs, extending from one end to the other of the control board. At various points along the line of this miniature canal, columns rise to various heights. These columns are scaled for reading, and indicate the rise and fall of water in the lock chambers when the operator, by means of the control handles, opens and closes the water gates in the actual canal.

On the top and near the edges of the board are located the control handles. These handles are operated through an angle of 90 degrees. They open and close the circuits to the electrical apparatus which works the lock machinery, located in the walls of the locks. Name plates show the "open," "close," and "off" positions of the handles.

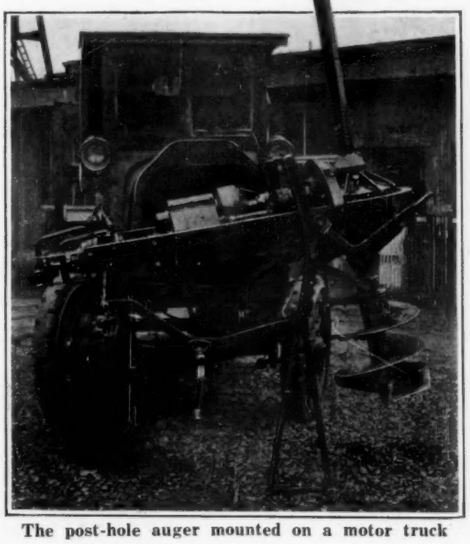
A special arrangement was worked out to take care of the question of interlocking. A series of vertical and horizontal bars is provided, the bars moving in a di-

(*Continued on page 460*)

The Earth-Boring Machine

IN 1914 when the first transcontinental telephone line was being constructed, there arose the necessity of an improved method of boring holes for poles. A survey of the field for available machines was made with the result that a power-driven auger mounted on the rear end of a horse-drawn wagon was purchased and put into use. This machine was powered by a four-cylinder gasoline engine and required a team of four horses to draw it through the territory encountered. This method of locomotion was slow indeed, and difficulties were invariably experienced when holes were to be spotted.

The limitations of their machine were apparent to the company officials, who set out to develop something better—and with a success revealed by our photograph. The power-driven earth-boring machine is mounted on the front end of the chassis of a motor truck. Because of the fact that the pole line invariably extends "cross-country," a truck having four-wheel drive is absolutely essential to enable the truck to negotiate the surface encountered in plowed fields, irrigation ditches, and the like. The mounting of the boring-machine is such that it is possible to bore a vertical hole with the truck on any negotiable grade; it is also possible to bore a hole at any angle up to 45 degrees from the vertical, with the truck on the level. The earth-boring machine is driven through a universal shaft from the power take-off of the truck transmission. Since there are four speeds and a reverse in the truck transmission, the earth-boring machine may be driven at a wide range of speeds, thus adapting it to soils of different natures such as adobe, clay, sand, hard-pan, et cetera. In keeping with the idea for which the machine was primarily designed a derrick with a movable boom is mounted on the truck bed about "midship" to facilitate the setting of the pole in the hole. It may be mentioned here that the pole is set with cross-arms bolted in place, thus effecting a saving of time, as it is much more convenient to bolt the cross-arms in place while the pole is on the ground. The same advantage is to be gained in the case of guy wires.

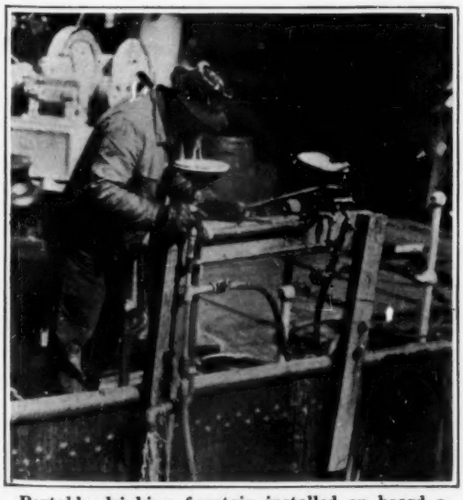


The post-hole auger mounted on a motor truck

The controls of the earth-boring machine and derrick are situated within easy reach of the truck driver, which obviates the necessity of changing his position to operate either the earth-boring machine or derrick, or of the necessity of having a separate operator for the operation of the earth-boring machine and derrick.

The driver spots the point of auger on the surveyor's stake and sets the brakes on the truck, shifts the compound gear of the truck to neutral, and pulls in the clutch on the earth-boring machine. The auger is fed

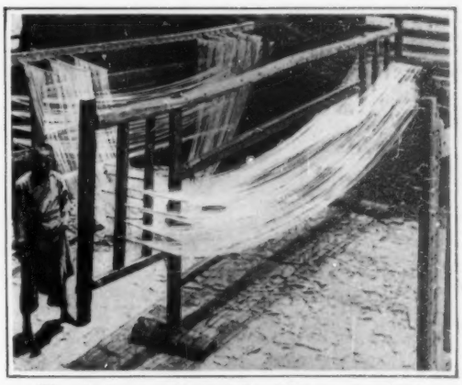
(*Continued on page 460*)



Portable drinking fountain installed on board a tank ship during her construction

Bringing the Drink to the Job

THE necessity of having to quit the job and go ashore for a drink, or the equally inconvenient alternative of having a bucket boy wandering about the job, was found irksome to the men and expensive to the contractor engaged in building a tanker in an Oakland, Cal. shipyard. So the inventive jack-of-all-trades who is to be found on every such job as this one got busy, with the result pictured. Two 2 by 4 planks were bolted to the side of the vessel, with a third placed across them. Two fountains of the ordinary variety were attached to the plank, and hose was run from them to the nearest source of water supply on shore. In this manner the men on the ship were able to satisfy their thirst with ease and without loss of time.—By *C. W. Geiger.*



The drying outfit used by Chinese spaghetti makers

Chinese Spaghetti

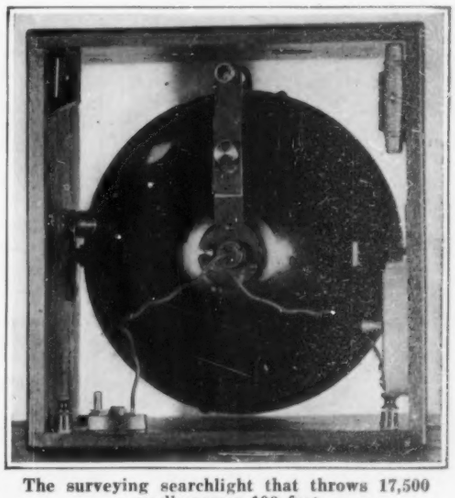
SPAGHETTI we ordinarily associate with Italy; and most of us have probably heard the tale of the American lady driving through Naples, who went into ecstasies over the delightfully artistic window curtains to be seen throughout the city, only to learn that she had been admiring the home-made batch of Italy's national food, hung in the front windows to dry as per long established custom. But China, too, has her spaghetti, or at least her foodstuff so similar to spaghetti in composition and preparation that we may employ the name. The methods of drying it are a trifle different, however, as our photograph shows. So far as the picture goes, it would be easy enough to impose upon the reader and tell him that this is one of the processes of oriental silk manufacture; but we are assured by the photographer that the slant-eyed workman is really engaged in the preparation of something to eat rather than something to wear.—By *James Anderson.*

The Surveying Searchlight

ECONOMY in the consumption of storage battery power as well as continuous employment for surveying parties in fog and smoke and even making possible night observations, are the notable advantages of a signal lamp of highly-concentrated reflecting powers recently designed by E. G. Fischer, chief of the instrument section of the United States Coast and Geodetic Survey. The high-powered light is a modification of a previous design which was an accompaniment of the theodolite in surveying lines up to 150 miles in length, the more recent lamp lessening considerably the number of dry cells required and is adapted to measuring angles of triangles, the sides of which are from 10 to 100 miles in length.

The newly-built signal lamp will displace the acetylene lamp, storage cells, oxy-acetylene outfits, and motor-generator sets, all of which are subject to be discarded by reason of their bulkiness, cost of maintenance, or unreliability. Surveying and mapping the entire country is one of the functions of the United States Coast and Geodetic Survey, city, county, and State surveyors looking to this government bureau for

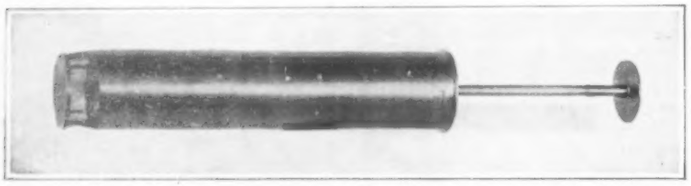
(*Continued on page 460*)



The surveying searchlight that throws 17,500 candle-power 100 feet

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



A pump-like device with a screened container for holding the parts of a watch that are to be washed and cleaned

Simplifying the Cleaning of Watches

BY making use of the usual hand-pump principle, Bert McCarty of Tampa, Fla., has developed and patented a device that simplifies the work of cleaning watches. The device, which is shown in the accompanying illustration, consists of a simple hand-pump fitted with a screen receptacle at the bottom, in which are placed the parts of the watch to be cleaned. The pump is then placed in any liquid that is to do the cleaning, and the pump is operated so as to pass the liquid through the screened receptacle. A more elaborate form of this device has a number of compartments in order that all parts can be washed at the same time; for instance, the heavy plates are placed in one receptacle, the small springs, screws, blocks and so on in another, the balance, fork and train wheels in another, and so on. In this manner more pieces can be washed at a time, while there is no danger of their damaging each other.

The Swimming Collar for the Beginner

THE main difficulty in the way of learning how to swim is that the novice's head goes under the water, causing fright and the loss of confidence. Now comes an American inventor with a swimming collar which eliminates the usual ducking and makes swimmers out of novices in short order, according to the claims.

The swimming collar, which is shown in the accompanying illustration, is a high, transparent, celluloid, cylindrical collar made water-tight at the bottom through the use of rubberized fabric that fits snugly about the neck. The top is also made of rubberized fabric and has breathing holes. The collar is quite light, weighing but seven ounces and floating like a cork upon the water. It lifts the head when in the water with a buoyancy of about ten pounds, therefore keeping the head from sinking.

The swimming collar which prevents the swimmer's head from going under water

A device that indicates the gravity test of gasoline and the condition of pumping station

A Check on the Accuracy of the Gasoline Pump

AFTER several years of experimental work on a gasoline pump tester, an American manufacturing company has finally succeeded in developing the commercial model shown in the accompanying illustration. This device is designed for attachment to an invisible gasoline pump, and converts this type of pump into a visible one.

For years, it is claimed, the public has paid for gasoline that it never received. This has taken place perhaps unwittingly by some dealers, owing to their lack of knowledge of the essentials of the installation of their pumping system. Inspectors and sealers of weights and measures have known for some time that there should be some device that would indicate to the public the condition of the pumping system, and also that it would help them to condemn pumps with faulty installation and place the gasoline pumps before the public with better accuracy.

The new device is claimed to remove these existing evils. It is made in four types, namely, one without a float indicator, one with a float indicator, one with a correct reading, combination thermometer and hydrometer, and one with a four-way reading hydrometer which indicates the gravity test of the gasoline.

Is Your Watch Accurate?

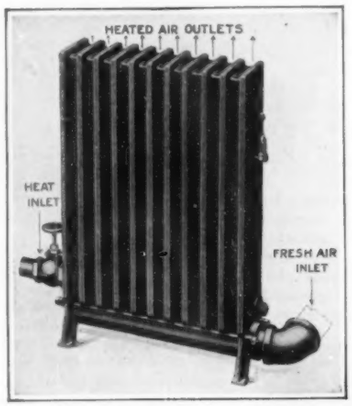
IF your watch is responsible for tardiness in meeting appointments or for missing a train, send it to the U. S. Bureau of Standards and have it tested. Any citizen of the United States has this privilege, the nominal charge being $1.50 for each watch, and errors are detected to the fineness of one-tenth of a second. Within the past two years the Government has tested 25,000 timepieces for manufacturing concerns, individuals and Government bureaus.

Watches owned by railroad men are usually the standard of accuracy in any community, but even these timepieces may fluctuate in keeping tab with the onward march of Father Time. So the Bureau of Standards has undertaken a new type of laboratory experiment—the railroad precision watch test. The standard of accuracy is gaged by the average efficiency of new railroad watches, certificates being issued to excellent timekeepers. The test extends over a period of 19 days, the watch be-

(*Continued on page 460*)

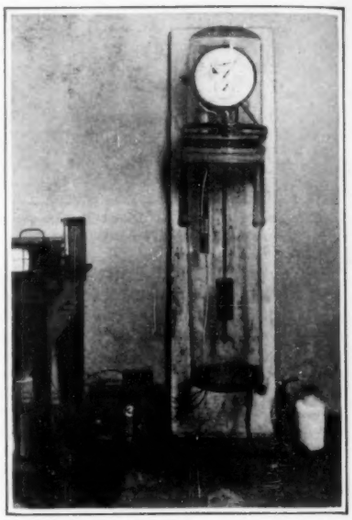
A Forward Stride in Heating and Ventilation

IT has remained for Wm. R. Hildebrand of Chicago to develop a new ventilating radiator on which a patent has been granted. This new radiator produces a constant air suction and air circulation by means of an adequate surface of contact whereby air is more rapidly and most efficiently heated. Connected with the outside, this new radiator sucks in fresh air, heats it to an agreeable temperature, and distributes it freely throughout the room. It is thus adapted to take in fresh air continuously from out of doors and supplant the vitiated air of the living room, office or workshop without subjecting the occupants to cold draughts.



A radiator that draws in fresh air and distributes heated air throughout room

The construction is quite simple. There is an air inlet running parallel with the heat inlet and these two conduits carry and distribute heat and air.



Precision clock used as standard for comparison in testing watches

Six Fuse Plugs In One

SPARE fuse plugs are seldom on hand when they are needed as renewals, following the blowing out of fuses from one cause or another. So users of electric current are often put to considerable inconvenience and delay for the simple reason that no spare fuses are kept in the fuse box. This human failing being quite common and seemingly incurable, inventors have of late been active in developing multiple fuse plugs, with the idea of making one fuse plug serve a number of times. One of these plugs is shown in the accompanying illustration, fully taken apart so as to show its three simple components. One member is the plug proper, another is a porcelain piece with six grooves in which are placed six fuse wires, while the third is a brass cap through which projects the straight handle of the porcelain piece. The current passes through the button of the plug, through the fuse wire, and through the spring contact which connects with the outer screw shell of plug. By giving the handle a slight turn, the spring contact or finger engages with another fuse wire, so that the plug is good for six blow-outs, after which a new fuse-carrying member can be inserted in the same plug for six more occasions.

Components of a newly introduced fuse plug that is good for six blow-outs before renewal

Our Tropical Timber Trade

(*Continued from page 444*)

shuttles. The little that now dribbles into our market is by way of reshipments from England. There is also the East London and the Knysa boxwood from South Africa but they are not as good as the Turkish and are mostly consumed by the European shuttle trade. Nearly all the boxwood on our market is from Venezuela, though some comes from the West Indies. The logs are smooth and straight but only a few inches in diameter, and weighing from 150 to 250 pounds. In addition to rulers, some of this wood is "ebonized" for black piano keys in place of the too costly ebony. For our shuttles the flowering dogwood and the persimmon tree of our forests have proved satisfactory.

The trade in lignum-vitæ of the West Indies dates back 400 years to the early Spanish explorers, who thought they had in this material the panacea for all man's ills. The name, meaning the wood of life, is now all that remains to remind one of the wonderful curative powers ascribed to this wood when for upward of two centuries it was the fetish of the medical profession. Modern science has stripped aside the veil of credulity and revealed an unwitting fraud. Now lignum-vitæ plays a different rôle, this time a legitimate one. Here is a wood of extreme hardness and weight, with its fibers veritably woven together, and saturated throughout with an oily resin—the wood of all woods for machinery bearings. The propeller shaft of every steamship revolves in a lignum-vitæ bushing. It is the only wood known that combines the necessary strength, toughness, and natural lubricating property necessary for this exacting purpose. It serves also for mallets, casters, pulley sheaves, bowling balls, watch-makers' anvils, masthead trucks in wireless telegraphy and other uses.

From Brazil, particularly from Victoria and Bahia, comes the mildly fragrant and richly figured rosewood or jacaranda. Though familiar to the trade for a long time and one of Brazil's best known woods, yet even today botanists are not sure as to the species or even the genus of the trees which produce it. There are various kinds of the true and no end of impostors, but the American trade prefers the black variety, jacaranda caviuna, while the violet, jacaranda violetta, appeals more strongly to the English trade. . The rosewood business is organized poorly or not at all. The native farmer cuts a tree or two a year, chops off the bark and light colored sapwood, and drags the log to the nearest store to exchange for a handful of provisions. From the various storekeepers the slowly accumulating lots make their way in primitive fashion to some collecting place at a river boat-landing or railroad station. Here they are hewn off smooth with adzes, and the best grades for veneer are sawn in two through the middle and any rotten portions in the heart cleaned out. The logs are halved by pit sawing, that is, one sawyer stands on the log and the other stands in a pit beneath. Such primitive methods must be replaced by modern ones if the rosewood business is to retain its fast loosening hold on the trade. Its principal use in this country is no longer for furniture but for spirit levels. A limited amount goes into billiard tables, phonograph cabinets, and handles for butcher knives. All told we use about a thousand tons a year.

The Brazilian rosewood has some near relatives in Central America which fill some special places in our trade. The clear ringing tone of the Honduras rosewood makes that wood the first choice for xylophones. About a hundred tons a year are imported solely for this purpose. Another wood is the cocobola from the west coast of Central America and from Panama. Fifteen hundred tons of these logs are made into knife scales (sides of the handle), small turned articles, brush backs, and policemen's clubs. The logs are peculiarly mottled with various shades of red, yellow, purple and black and the colors are fast. Certain grades of this wood have an evil reputation among the workmen in our factories, as the dust is likely to cause a dermatitis, somewhat resembling ivy poisoning. The East Indian satinwood has a similar reputation, particularly among the workers in Glasgow.

The true satinwood comes from India and Ceylon and is used here in limited quantities for fancy brush backs, handles for toilet articles, and veneers for inlay in cabinet work. The West Indian satinwood comes here in small lots of small squared logs and finds its way to brush-back makers. That from San Domingo is considered better than the material from Porto Rico, Jamaica and the Bahamas.

Ebony is popularly supposed to be as black as night, but a lot of it isn't. The jet black kinds are the Gaboon, which is like hard charcoal, and the Madagascar, which is also called Nossi Be, Tamatave, and other names signifying the place of origin. These are used principally in the manufacture of musical instruments, *e.g.*, finger boards for violins and black keys for pianos, and for small handles of surgical instruments and fine silverware. The logs of Gaboon are small and may be only mere shells and fragments which have lain long in the woods; the Madagascar comes in the form of small, round, straight-grained sticks upward of 10 feet long. The scant supply and high price have led to the substitution of cheaper woods which are stained black or "ebonized."

The Madagascar and the Celebes ebony is mottled black and reddish brown, and comes in large sized logs. The wood is used in considerable quantity for brush backs, umbrella handles and to a small extent for policemen's clubs. The Cameroun ebony is lighter in color and is little used except for small articles of turnery. The foregoing are true ebonies and are closely related to our persimmon tree. The ebony family is widely distributed throughout the tropics and there are over 200 species. The Camazon of the Philippines is a splendid and beautiful wood but like others of the group it is rare and hard to get.

The brown and the green ebonies are of a different family—the locust or pea family—to which so many of the hard and heavy and highly colored woods of the tropics belong. The brown ebony or coffee wood comes from Venezuela and Mexico where it is known locally as granadillo. It is extremely hard, heavy and tough and arrives in the form of logs mostly 12 to 14 inches in diameter and about 6 feet long. Those from Venezuela show from 1 to 3 inches of white sapwood but the Mexican logs are hewn to the heart. This is *the* umbrella handle wood. It is also employed in place of live oak for caulking mallets. The wood is called partridge in the English market. Green ebony or cocas from Cuba and Jamaica has always been the favorite for flutes and mouth pieces but it has become so scarce that the African blackwood has largely superseded it.

At one time there was considerable teak on our market but the best of it finally reached the prohibitive price of 80 cents a board foot (a board foot being a square foot of lumber an inch thick). Four kinds are recognized in the trade, namely, in order of preference, Burma, Siam, Cochin-China, and Java. Teak is imported in the form of flitches (sawn planks) 3½ to 6 inches thick, 6 to 14 inches wide, and from 6 to 30 feet long. Its principal use is in shipbuilding for railings, decking, steps, doors, etc. Formerly it was employed for backing for armor plate in battleships but concrete has taken its place there. Teak has the greatest reputation of any wood in the Far East.

The best known wood from British Guiana is greenheart, which belongs to the same family as our sassafras. This hard yellowish-green wood is noted for its lasting qualities in salt water and is very serviceable in wharf and dock construction. Large quantities went into the locks of the Panama Canal but very little is coming into our market. There is a fine opportunity for it in replacing the broken piling and rotten planking in New York's ferry slips. A hundred thousand billiard cue butts are turned out of this wood every year in this country. This industry makes use of every available tropical wood of the proper weight.

Makers of fishing rods make a special demand for tropical woods. They use some truce greenheart, some Surinam groenhart, some massaranduba or bullet wood, Macassar ebony, rosewood, Haytian red cedar (juniper), bamboo, degame and lancewood spars. Degame spars come from Cuba in the form of perfectly straight smooth sticks 6 to 12 inches through and 13 feet long. From 50 to 100 tons are consumed here annually. Lancewood spars are from Jamaica—small slender sticks 5 or 6 inches in diameter and 13 feet in length.

A wood which has been recently introduced into our market is the balsa, mostly from Central America. This is one of the lightest woods known, some grades being lighter than cork. After waterproofing with paraffine it makes an excellent substitute for cork for all kinds of floats, life preservers and rafts, surfboards, etc., as well as for purposes of insulation as in refrigerators. Plantations of these trees are being established on exhausted [redacted] lands and they reach timber [redacted] about three years. There is au[redacted]cord of one tree which increased in thickness at the rate of an inch a month for the eight months it was under observation.

Various dye and extract woods find a market here. The quebracho from Paraguay and Argentina is the source of large quantities of tannin extract. This is a specialized industry and the timber does not enter the general timber trade. The name quebracho means axe-breaker, in appropriate reference to the hardness of the wood. Chief among the dyewoods are logwood and fustic from Mexico, Hayti, Jamaica, San Domingo, Central America, and Colombia. Then there is the brasillette from Mexico and Central America and Brazilwood from the country named after it. The latter wood was used during the war but the yield of dye is too low and the cost too high under normal conditions. Selected straight-grained, fine-textured sticks of this wood are in demand for violin bows, being known to the makers as Pernambuco wood. An occasional bow is also made from the peculiarly mottled South American snakewood or letter wood but it is not as "lively" as the Pernambuco bow.

The list is not complete but it embraces the staples of the trade. New woods are making a sporadic bid for favor, but too often under cloak of some established name. In time our tropical timber trade will experience a great change, will no longer confine itself to the rare and fancy woods, but extend to the commonplace materials of construction. But that time is not yet at hand and before it arrives much pioneer work will need to be done and much opposition overcome.

The Burning Mines of the Hocking Valley

(*Continued from page 445*)

all during the former winter when, at times, the temperature was fourteen degrees below zero.

At New Straitsville are two brothers, now the proprietors of a general store, who are said to have lost a fortune in trying to reclaim a portion of the fire area. They purchased a large section of the land, entirely surrounded by fire but itself

(*Continued on page 457*)

Old Glory is now on the Seven Seas

AMERICAN SHIPS ARE AVAILABLE FOR YOUR OCEAN VOYAGE

New combination Passenger and Freight Ships, Fast, Luxurious Steamers.

Key number beside ship's name indicates operator shown bottom of column.

EUROPE

Queenstown, Boulogne and London
From New York

June 7—July 12—August 16—September 20—Old North State (159).
June 28—August 2—September 6—Panhandle State (159).

Bremen and Danzig
From New York

July 13—August 30—Hudson (159).
June 8—July 23—September 7—Susquehanna (159).
June 15—July 28—September 14—October 20—Potomac (159).

Naples and Genoa
From New York

June 30—August 13—September 24—Pocahontas (159).
June 8—July 20—August 31—October 12—Princess Matoika (159).

Plymouth, Cherbourg and Bremen
From New York

June 22—July 23—August 24—September 28—America (159).
July 30—August 27—September 24—George Washington (159).

SOUTH AMERICA

Rio de Janeiro, Montevideo and Buenos Aires
From New York

Huron (91).
June 8—Aeolus (91).

FAR EAST

Honolulu, Yokohama, Kobe, Shanghai, Manila, Hongkong
From San Francisco

Golden State (105).
July 23—Empire State (105).

Yokohama, Kobe, Shanghai, Hongkong, Manila
From Seattle

June 18—August 27—Wenatchee (106).
July 9—Silver State (106).
July 30—Keystone State (106).

HAWAII, PHILIPPINES, EAST INDIES

Honolulu, Manila, Saigon, Singapore, Colombo, Calcutta
From San Francisco

June 11—Wolverine State (105).
July 14—Granite State (105).

COASTWISE AND HAWAII

Havana, Canal, Los Angeles, San Francisco and Hawaiian Islands
From Baltimore

June 11—Buckeye State (80).

80 Matson Navigation Co.
120 Market Street, San Francisco, Cal.
26 South Gay Street, Baltimore, Md.

91 Munson Steamship Line
67 Wall Street, N. Y.
Tel. Hanover 5120.

105 Pacific Mail S. S. Co.
10 Hanover Sq., N. Y.
Tel. Bowling Green. 4630.
621 Market Street, San Francisco, Cal.

106 The Admiral Line
17 State Street, N. Y.
L. C. Smith Bldg., Seattle, Wash.

159 U. S. Mail S. S. Co., Inc.
45 Broadway, N. Y.
Tel. Rector 6300.

U.S. SHIPPING BOARD
Washington, D.C.

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

HAT LINING.—B. HOROWITZ, 552 Broadway, Brooklyn, N. Y. This invention has for an object the provision of construction wherein the lining of a hat may be stitched in by machine and at the same time give the appearance of a usual hand-stitched lining. A further object is the provision of a hat lining in which there is provided a substantially annular portion to be stitched in place and a central portion to be clamped in place.

Electrical Devices

TELEPHONE COLLECTION BOX APPARATUS.—O. A. PEDERSEN, 509 Willis Ave., Bronx, N. Y. Among the principal objects which this invention has in view are to secure prepayment for telephone services in multi-branch installations, to provide a fee payment system for house telephones and to avoid interference in the use of the branches of said system.

ELECTRICAL TRANSMITTING APPARATUS.—H. K. HARRIS, 96 Victoria St., Westminster, London, England. This invention relates to electrical transmitting apparatus of the hand set type, manipulated by hand or power for transmitting electrical impulses to an advertising or other device adapted to be set into position by such electrical impulses, and combined, if desired, with automatic means for reversing the direction of movement of the device.

Of Interest to Farmers

VALVE FOR IRRIGATION PROJECTS.—W. J. COLEBURN, Wilkins, S. C. The invention more particularly relates to a simple, effective valve structure for use in connection with tiles for transporting water in irrigation projects, the object being to provide an inexpensive arrangement which may be readily associated, in fact molded, in connection with irrigation tiles at whatever points may be desirable for the location of the valve boxes.

Of General Interest

BOOKCASE AND MAGAZINE HOLDER.—W. C. WILSON, Johnson City, Tenn. The invention particularly relates to a combined device wherein the books and magazines as well as papers may each be supported with its title

A FRONT ELEVATION PARTLY BROKEN AWAY

exposed and in readily accessible position, the object being the provision of a simple, inexpensive device adaptable to either the home or public libraries, and capable of being made in a variety of materials to suit its surroundings.

POWDER PUFF.—W. G. KENDALL, 118 Market St., Newark, N. J. Among the objects of the invention is to provide a powder puff which is simple and durable in construction and cheap to manufacture, the parts being quickly and accurately assembled without resorting to sewing or requiring highly skilled labor. Another object is to firmly fasten the body parts of the powder puff material in stretched position without danger of the parts becoming detached.

APPARATUS FOR TEACHING DANCING.—S. E. FEIST, 1050 Broadway, Brooklyn, N. Y. The invention relates to a construction which will automatically cause a person to assume a proper position when dancing. An object is to provide a form or dummy and supporting means therefor which will cause a student to go through the proper movements in dancing when using the form as a partner, the form causing the student to initiate all the moves and thereby experience the necessity of acting on his own initiative.

COLLAPSIBLE TUBE HOLDER.—J. H. GIBBS, 136 Valley Rd., West Orange, N. J. The object of this invention is to provide a holder which will act in the double capacity of a holder and means for collapsing the tube to any desired extent. Another object is to provide a holder constructed in such manner as to be readily applied to a wall or other support at a point of ready access.

CONCENTRATED COCOANUT MILK AND PROCESS OF MAKING SAME.—W. S. COOKSON, Taiping, Perak, Straits Settlements. An object of this invention is to produce a vegetable food product, similar in composition to a pure rice, natural cream, which by dilution with water to form four to ten times its original volume, provides a product varying in richness from that of ordinary dairy cream down to that of ordinary dairy milk, and one which is suited to all uses to which dairy milk or cream are ordinarily put.

COCOANUT FOOD PRODUCT.—W. S. COOKSON, Taiping, Perak, Straits Settlements. An object of this invention is to provide a cocoanut product which contains a relatively small amount of pure natural oil or fat, and which therefore is easily digested as compared with desiccated cocoanut containing a relatively greater amount of fat, by the weakening of the cell walls of the tissue of the endosperm or "white meat" of the cocoanut by roasting the same until it is crisp and dry.

GROUSER.—S. M. WADE, 4000 Broadway Ave., Oakland, Cal. The invention has for its object to provide a device of the character specified, capable of attachment to a link of a tractor chain to increase the traction of the chain, wherein the grouser is easily attached and may be easily detached when desired.

SIX STREAM DISTRIBUTING ATTACHMENT FOR SODA WATER DRAFT ARMS.—C. R. RAGSDALE, 57[illegible] Ave., St. Louis, Mo. The invention relates to soda water fountains. The general object is to provide an attachment to be applied to the draft arm in lieu of the usual hard rubber nozzle found thereon, and whereby to produce speedy service, the attachment providing a plurality of distributing members preferably three, and set in triangular relation so as to permit of the operator filling either one, two or three glasses at a time.

CRATE.—C. A. STEWART, c/o Public School 51, Richmond Hill, L. I., N. Y. Among the objects of the invention is to provide a crate for packing fruit. A crate constructed according to the invention permits of a packing of grape baskets in a particularly compact manner whereby the crates are not subjected to rough handling as usual. A further object is to construct the crate in such manner that it provides a handle which will at all times serve to prevent danger of the crate being placed wrong side up.

Hardware and Tools

PIPE AND NUT WRENCH.—C. MCCARTER, address McCarter & Evans, Decatur, Ill. This invention particularly relates to a nut and pipe wrench which has for its object to provide a quick setting feature whereby the parts may be quickly set to the desired size. Another object is to provide a wrench which embodies means for locking the movable jaw in any set position.

ADJUSTABLE HAND REAMER.—F. P. MILLER, c/o McCroskey Reamer Co., Meadville, Pa. The object of the invention is to provide an adjustable hand reamer arranged to insure a proper and accurate guiding to the reamer when reaming long bores with a view to produce a bore true throughout its length. Another object is to securely hold the cutters in place on the head of the reamer.

LOCK.—B. F. MCCARTHY, 35 Clarkson Ave., Brooklyn, N. Y. The primary object of the invention is to provide a mechanism which is capable of being attached to the knob spindle of an ordinary door latch in such a manner that the operation of the knob spindle is prevented until various mechanisms of the device have been set. A further object is to so construct the mechanism that the combination may be changed from time to time at the will of the operator.

SINE BAR.—H. S. NODDINGS, 1052 State St., Springfield, Mass. The invention relates to measuring instruments; its object is to provide a sine bar arranged for convenient use on metal working tools such as lathes, and to permit accurate testing of all kinds of work. Another object is that by the use of the sine bar chances of errors in setting machine tools for making accurate angles are reduced to a minimum, and the user is enabled to set the sine bar quickly as well as accurately.

FISHING TOOL.—J. F. MCDOWELL, 2015 Laurel St., Shreveport, La. The object of the invention is to provide a tool which may be inserted into the top of a pipe, well casing or drill stem, and which when once inserted cannot be withdrawn until released, the arrangement being such that the tool may move freely downwardly in the pipe but clamps the pipe when it is moved upwardly and will be held against accidental displacement.

Heating and Lighting

COPRA COOKER.—A. BARRA, 26 Alhambra St., Manila, Philippine Islands. The invention relates to a cooker which while capable of other uses, is more particularly intended for use in cooking copra, which is the dried kernel of the cocoanut, the cooking being preparatory to the extraction of the oil. The general object is to provide a cooker in which cooking may be effected in the shortest possible time, and with a minimum handling of the material.

CONDENSER.—R. E. THOMPSON, Deming, N. M. The invention particularly relates to devices for maintaining vacuum for the exhaust of steam turbines or steam engines. The primary object is the provision of a condenser which will to a large extent transfer its heat to air, directly or through the evaporation of water on the surfaces of said condenser exposed to air, and the provision of a condenser unit which will be self-sustaining in use to maintain a considerable internal vacuum without collapsing when exposed at its exterior to atmospheric pressure.

Machines and Mechanical Devices

COMBINED DRILL AND UNDERREAMER.—W. T. S. WARNER, Yuma, Arizona. The primary object of the invention is to provide a well drilling structure which will enable the well to be drilled and under reamed to enlarge the hole for the well casing in one and the same operation. Another advantage consists in enabling the hole to be drilled at any depth with but one size of casing throughout from top to bottom.

INDICATOR.—A. F. FERRAND, 375 Delevan St., c/o W. Simon, New Brunswick, N. J. The invention relates particularly to an indicator which is used in connection with metal-working machinery such as milling machines, boring machines and the like, to facilitate the lining up of the work with respect to a tool-holding device, and to readily indicate during the lining up process the degree of eccentricity of the work with respect to the tool holder.

ELEVATING AND UNLOADING DEVICE.—F. SIBRAVA, Wilson, Utah. The object of the invention is to provide mechanism consisting of a barge or body for containing a load and a wheeled support having a superstructure within which the barge has vertically guided movement together with means controlled by the movement of the wheeled support for raising the barge, and wherein the barge may be tripped to permit it to take an inclined position to unload the contents thereof.

SHEET DELIVERY FOR PRINTING MACHINE.—C. WINKLER, Berne, Switzerland. The object of the invention is to provide a device for taking printed sheets from impression cylinders of printing machines in which tapes take the sheet with the printed side up from said impression cylinder at the surface speed of the same and deliver the sheet at a decreased speed to a system of open cords or tapes moving at the same decreased speed and arranged to be alternately wound on and off a spindle.

KNOTTER.—A. E. CRANSTON, 639 Peyton Bldg., Spokane, Wash. This invention is particularly adapted for use in connection with binding machines; it relates to knotters of the revoluble type which are used for twisting the several ends of a loop of wire subsequent to the wrapping of a bundle of shingles, staves, or the like for securing the same together for shipment.

SANDPAPER DRUM.—W. L. BROWNE, 323 Alameda St., Vallejo, Cal. The invention relates to sand-papering machines such as are used for smoothing, polishing, shaping and grinding wood or other material. One of the objects is to provide a drum upon which the sheet of sand paper may be securely and evenly clamped and easily and quickly adjusted to properly conform to the drum.

Medical Devices

SANITARY CASE.—C. A. GREENE, 152 W. 45th St., New York, N. Y. Among the objects of this invention is to provide a case compactly and conveniently arranged to carry receptacles of various forms and sizes, so constructed that the various parts carried are readily accessible, such parts including an instrument case and contents, sterilizing apparatus, and suitable bandage and cotton receptacles. The device may be used for any purpose, but is particularly adapted for chiropodists.

Pertaining to Recreation

TOY.—A. P. BERGGREEN, c/o Northern Pacific R. R. Co., St. Paul, Minn. The object of this invention is to provide a device which is adapted to project toy projectiles or missiles through the air for a relatively great distance and with a high degree of accuracy, and which is of sturdy and durable construction, reliable in action and easy and inexpensive to manufacture.

Pertaining to Vehicles

PROCESS OF AND MOLD FOR REBUILDING TIRES.—H. G. BALLOU, 737 S. Westlake Ave., Los Angeles, Cal. The primary object of the invention is to provide an apparatus by which a progressive process of treating, rebuilding and retreating old and used tire casing may be carried out. A further object is to so construct a tire mold that in addition to a new tread being formed on the tire treated stock may be applied to the side walls of the tire.

TRACTION MOTOR.—G. YATES, 3215 Carnegie Ave., Cleveland, Ohio. The invention relates particularly to the rotating armature type of traction motors. An important object is to provide a traction motor in which the effective driving power will be transmitted directly to the car wheels, thereby eliminating the use of transmission gearing and increasing its efficiency. Another object is to provide a motor which will be simple in construction and inexpensive to manufacture.

STEERING WHEEL MOUNTING.—E. F. DAVIS, 403 Hoffman St., Elmira, N. Y. This invention has for its object to provide a mounting for permitting the wheel to be held firmly in a plane perpendicular to the steering column or to be tilted forwardly into a plane parallel with the said column, where it will be out of the way while entering or leaving the motor car.

MONOCYCLE VEHICLE. — C. POMILIO, Rome, Italy. The invention refers to a monocycle vehicle which is shaped as a large roller or hollow drum of great diameter and of a width sufficient to contain the driving plant and materials for the transportation of passengers and crew on open land destitute of roads, the same being protected against external attacks and provided also with means of offense when needed.

Designs

DESIGN FOR A POWDER CONTAINER OR SIMILAR RECEPTACLE.—C. S. HUMPHREY, c/o Manhattan Can Co., Bush Terminal Bldg., No. 10, Brooklyn, N. Y.

DESIGN FOR A HINGE.—A. KOETTING, 423 Wythe Ave., Brooklyn, N. Y.

DESIGN FOR APPLIQUE TRIMMING FOR WEARING APPAREL OR ARTICLE OF SIMILAR NATURE.—O. E. MAUL, 90 Vista Place, Mount Vernon, N. Y.

DESIGN FOR A NETTED FABRIC.—H. T. MENDELSOHN, 40 W. 25th St., New York, N. Y.

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The Burning Mines of the Hocking Valley

(*Continued from page 455*)

clear. They bought the land with the expectation of checking the flames and stripping the earth from the coal so that it could be mined cheaply and quickly. Before they could begin operations fire appeared on their land. All attempts to halt its progress have been futile. Brick walls were built across the mine tunnels with the hope of smothering the fire, but these apparently had no effect. Double brick walls were then tried and after that a space was walled off and filled in with dirt. This latter scheme was partially successful and believing the fire was extinguished, preparations were made to strip the land, but before these were completed three new craters were blown out and the fire started with renewed energy. By this time the firm's finances were exhausted and the project was given up as hopeless.

The State of Ohio likewise has abandoned efforts to stop the fire after several ineffectual attempts. In one of the earlier attempts water was pumped into one of the mines for three years continuously. At the end of that time no impression had been made on the fire. It is believed the intense heat turned the water into steam before it reached the coal, rendering it ineffectual. Chemicals also were tried without success. In some rare instances the fire has been stopped in spots, only to break out in others near by.

This is really the principal difficulty of the situation. If the fire were burning in a single direction or from one center, it might be stopped at an expense justified by the value of the coal to be saved. But the fire has burned most readily along the outcroppings of the vein and as a result it is burning in hundreds of places scattered all over the territory.

The fire is the cause of many freakish occurrences. Not long ago an aged miner was looking at a section of sunken road and commented on the soundness of the ground he was standing on when it suddenly gave way. He tumbled into what had been an old shaft and he was able to make his way out without injury.

In the spring the vegetation on ground warmed by the fire to the proper temperature becomes green and the flowers bloom a month or more before the usual season. Other areas are so hot that even in winter heat waves arise from them as though from a giant stove top. Smoke issues from the most unexpected places. In one spot smoke issued from a hollow tree although no other smoke appeared near by.

The most imposing sight, no doubt, is at "Smoke Valley." It is, as its name indicates, a wide valley which has all the appearance of a giant cauldron. In places here the earth has been churned by upheavals and sinkings until it resembles a shell-torn battlefield. The simile applies as well to the whole region. Certainly the battle areas of France present a picture of desolation little more striking than this.

Weighing the Ten-Millionth of a Milligram

(*Continued from page 445*)

a millionth part of a milligram, the volume of the bulb and change in air pressure being known. Minute weights of pure quartz are used as well, the value of which has been ascertained by comparison with "air-weights." An alternative method consists of using "magnetic weights" in the place of air-weights; this involves the use of a measured electric current. The range of weighings depends on the size of the beam; with one 5 centimeters in length the maximum load is between 100 and 200 milligrams, and the setting can be made to within a ten-millionth part of a milligram.

The oscillations of the balance are read by optical means, a beam of light being reflected on a vertical scale from a minute mirror fixed to the beam of the balance. The mechanism of the balance by which its beam is suspended from or lifted off the fibers is controlled by an electromagnetic arrangement, without any material connection through the walls of the balance case.

Some important improvements, viz., an arrangement allowing the quartz fibers within a few minutes to be placed in position or detached and an attachment for varying the sensitiveness of the balance, are due to Dr. Strömberg. If a fiber should be accidentally broken a reserve fiber can be quickly inserted without removing the balance from its place, in fact, with the same ease as a string is replaced on a violin.

A balance surpassing a hundred thousand times the sensitiveness of the ordinary chemical balance, of course, opens up practically unlimited possibilities of scientific research and is bound to become indispensable to physical and chemical laboratories. Some highly interesting subjects have already been investigated by Dr. Petterson, viz., the gradual loss of weight of a silica sphere in a vacuum at temperatures of 600 to 800° Cent., the changes in weight of a piece of gold subsequent to heating, and the magnetic properties of pure nitrogen and hydrogen gas. It is now expected to investigate the pressure of light, the measurement of absolute temperature, and the loss of mass accompanying loss of energy.

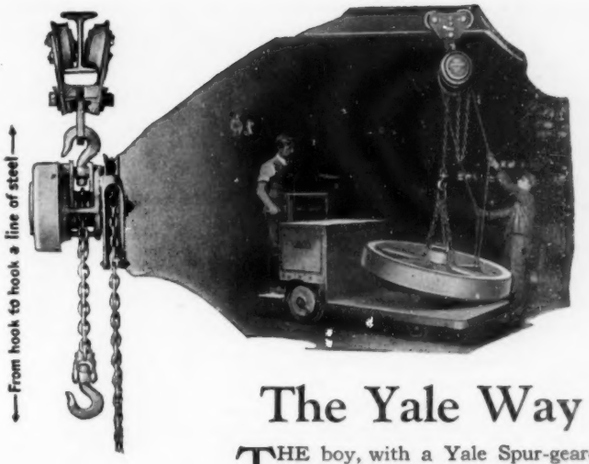
Revolutionizing an Industry

(*Continued from page 446*)

Wisconsin has found that community cooperation is fundamentally essential for the practical and profitable production of hemp. Machinery for harvesting the crop is expensive and usually must be owned in partnership by a number of neighbors. The mills for separating the hemp from the woody stems cost anywhere from $10,000 to $50,000, depending on their capacity and equipment, and must be necessarily located in sections where hemp growing is a permanent business. It is essential that from 500 to 750 acres of hemp be produced annually to keep each of these mills busy. This involves the concentration of production around definite milling centers so that sufficient raw material is assured to make the operation of the mills profitable.

To a certain extent hemp is a crop which prospers only under proper conditions of soil and climate. It is not adapted for universal culture in all parts of this country but it provides propitious opportunities for successful production in territories where the local environments are favorable for its growth. It prospers in the humid sections of the temperate zones, although some of the birdseed varieties mature in from two to three months in northern Russia. For seed production, hemp demands a growing season of six months or longer while for fiber production it will mature in four months. Hemp has been produced successfully in the United States only in sections where the annual rainfall amounts to at least 30 inches. Wisconsin's climate is excellent for hemp growing as the autumn months are cool and moist, conditions which promote the efficient seasoning and retting of the fiber.

It is essential to harvest fiber hemp at the right stage of maturity or else deterioration will result. Under Wisconsin conditions, hemp harvest season occurs between September 10th and October 1st. Practically all the foreign supplies of hemp are still harvested by hand and it has only been since 1917 that an efficient mechanical harvester has been perfected and extensively used in this country. It cuts the hemp and spreads the stalks in even swaths, performing this work much better than it can be done by hand. The American hemp crop is produced by dew-retting systems, that is, exposing the hemp to rains, dews, frosts and sunshine



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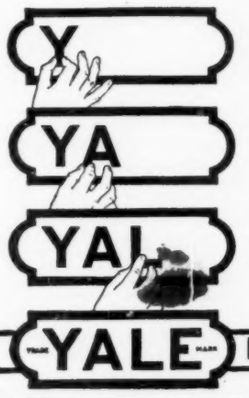

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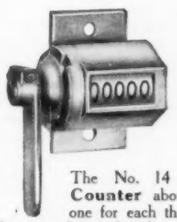

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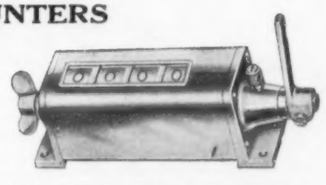

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spread out on the field which produced the crop. This effects partial decomposition so that the inner bark is loosened from the wood and the fiber can be more easily separated from the stalks. Usually it takes from four to ten weeks to dew-ret the hemp where the weather conditions are favorable. It is of maximum importance that the hemp be properly retted before being removed from the field and only the experienced grower knows exactly when this condition is reached.

Subsequently, the hemp stalks are gathered and bound in bundles which then are shocked up like corn. All this work was done by hand until 1918 when a gather-binder was invented which collects the stalks from the swath and binds them together. In regions where central breaking mills are operated, the bundles of hemp are delivered to the mill as soon as possible after shocking where the stalks are broken immediately. Where some time must elapse before the hemp can be transported to the mill, the practice is to stack the bundles so that the crop will pass through a sweat like small grain. Experience in building stacks is necessary as where the crop is not properly stacked and the bundles are needlessly exposed to weathering, heavy losses of fiber will result.

It is necessary that hemp be wholly dry when broken and the profits from the crop often hinge on the success of this activity. Formerly, the custom was to have portable machines which journeyed itinerant-fashion from farm to farm to perform this work but weather uncertainties always markedly limited such operations so that the modern plan is to kiln-dry the stalks at the mill before they are broken. The traditional practice up to the last few years was to break the crop—crushing the wood underneath the layers of fiber so as to favor the easy separation of these two materials—with a hand brake which was a tedious, costly and strength-racking practice. The average, experienced worker could only break from 100 to 200 pounds of cleaned hemp daily by hand. Industrial science has been responsible for the making and successful operation during recent years of power brakes which accomplish the work mechanically by means of fluted rollers, and thus work more efficiently and more cheaply than hand labor. The modern hemp mill consists of a receiving room, dry kilns, breaking room with brakes, scutchers and balers, boiler room, engine and fan room.

In the dry kiln the excess moisture in the hemp stalks is removed by the use of a hot-air blast. The dry stalks are then fed into the breaking rolls where they are crushed and thence pass over a series of shakers where the loose hurds or woody portions are separated from the fiber. Then the fiber passes through scutching wheels which remove the remnant hurds. The fiber which is then fairly cleaned is baled and sold to cordage and spinning mills. Formerly, the scutching was done by hand, the uncleaned fiber being whipped over the hand brake until it was free from hurds. The present scutching machinery consists of from 2 to 4 large cylinders equipped on the exterior with wooden slats. The cylinders are stationary and revolve toward each other. As the fiber passes between the scutching cylinders, the hurds are all combed off.

The average hemp crop in Wisconsin yields from 1,000 to 1,200 pounds of fiber an acre, being higher than the production in Kentucky and only excelled by that of California. The fiber consists of long fibers, called line, which are worth about three times as much as the shorter fibers, called tow, the total fiber supply usually containing between 10 and 20 per cent of tow. One thousand pounds of rough fiber will produce about 850 pounds of line and 150 pounds of tow. Usually the average well retted and dried crop of stalks amounts to three tons to the acre which will yield 20 per cent by weight of rough fiber. Green hemp stalks contain about 60 per cent more water than when they are thoroughly retted and dried and hence a yield of three tons of retted stalk means an initial production of 7½ tons of green material. A first class crop of hemp usually brings in a gross return of from $75 to $100 an acre while the cost of production is only about $10 or $11 more per acre than it is for a crop of small grain such as wheat. The profits from the hemp crop are large and dependable, and indications are that the industry will be materially extended in the near future.

Before hemp or fiber can be spun into yarn, it must be either carded or hackled—submitted to combing processes by power machinery at the spinning mills. These operations remove foreign materials and reduce the fiber to finer, uniform strands. In the past, much of the Kentucky crop was hackled by hand and even today this costly method is still followed in some southern mills. However, the potential tendencies of the hemp growing and milling industry will be to make more extensive use of modern machinery which performs cheap and efficient work.

As matters stand at present, the hemp industry needs more certain sources of cheap and satisfactory seed. Kentucky bottomlands have supplied much of the seed crops used up to this time but the prices demanded for Kentucky seed are exorbitant and new sources of seed are now being developed. In some sections, a standard market classification of the locally grown fiber is prerequisite potentially if the industry is to expand without trouble. The growers must exert every effort to produce the best quality hemp while the millers must specialize in their abilities to distinguish between the different grades of hemp and so to handle the material that it will, subsequently, be in the best possible condition for further processing in the spinning and cordage mills.

Is the Practical Helicopter in Sight?

(Continued from page 447)

like an elevator, so to speak, several men being in a circular metal chamber or cabin on top of the helicopter.

Briefly, the Petroczy helicopter consists of a triangular frame which carries three 120-horsepower LeRhone engines. The engines drive two co-axially mounted air screws measuring some 20 feet in diameter, in opposite directions by means of the gear drive. These screws turn at 600 revolutions per minute. Above the engines and screws is mounted a metal turret or cabin for the crew, while below the power plant are the shock-absorbers for landing.

In a recent test of the Petroczy machine the crew entered the top turret. The motors were set going at full speed. The big screws whirled round. Then, held captive by the restraining cables, which were paid out gradually, the machine rose straight up into the air till it was at a height as great as 160 feet. Here it remained stationary, providing, as the inventor claims, an ideal machine for observation work in connection with artillery fire.

The Petroczy machine is hauled down by the cables when the flight is to be terminated. No attempt has as yet been made to throttle down the engines in order that the helicopter may sink down of its own accord, because there are certain problems of stability yet to be solved. In fact, it is reported that during a recent flight the engines ceased to function properly and the machine began to oscillate, threatening to side-slip. The crew made use of the parachute, always carried in the cabin, and succeeded in reducing the rate of descent so that a safe landing was effected.

It is understood that Louis Brennan of England has developed a helicopter very much along the same lines as Lieut.

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Petroczy, which is to be tested shortly. It is said to represent a marked improvement over the Austrian machine.

Another recent machine is the Peugeot-Oehmichen helicopter, which makes use of a gas bag for part of the lifting force. This machine employs two special screws 20 feet in diameter, driven by a 20-25-horsepower engine. The hydrogen gas bag, mounted at the top of the machine, has a lifting effect of about 170 pounds, or about one-fifth of the total weight of the machine with the pilot. In recent tests at Valentigney, France, this machine made free flights at six or seven feet altitude, as shown in the accompanying illustration.

The problem of helicopter flight is far from solved, for once the machine is developed that can rise vertically, it will be necessary to propel it in any direction. The two methods generally proposed for propelling are to manipulate the helicopter screws in such a manner as to upset the normal equilibrium and therefore obtain a forward movement, and to use an additional screw or group of screws for purely propulsive purposes. The Pescara, Berliner and other well-known types simply tilt the column that carries the horizontal crews, obtaining, so they claim, a forward movement.

Another interesting type of helicopter is the Damblanc-Lacoin "Alerion," of French design and construction. This machine makes use of two huge lifting members, each consisting of four blades of about the same general shape as the usual electric fan, but built of wooden framework with a fabric covering. Two rotary engines coupled together drive the screws or lifting members. The body of the "Alerion" follows the usual lines of the airplane fuselage; indeed, the idea behind this construction, with its elevator and rudder at the end of the fuselage, is to obtain some of the volplaning possibilities of the usual airplane in case of engine failure. The alteration of the lifting members causes horizontal motion. This machine is but one of many of the same general class in which the helicopter principle is made part of the usual airplane construction.

The fact remains, despite the several interesting attempts now being made, that little has been done in the way of insuring helicopter flight in the near future. The successful helicopter remains to be developed, and once it is developed, there must be a repetition to a greater or less extent of the spectacular though costly days of pioneer aviation. Intrepid pilots will have to risk their lives to master the new machines and to learn how to operate them, and it is doubtful if very much of their airplane experience will prove of more than general value.

A Study in Magnitude

(*Continued from page 451*)

give ample room for sixteen automobiles and motor trucks to pass, abreast, across the bridge, if a rush of traffic made this necessary. On the lower deck will be ten railway tracks over which will pass the transcontinental trains of all the railroads that come into Jersey City from the west, and also such freight trains as are destined for Manhattan, the Bronx and Long Island.

A Weather-proof Bridge

A new and highly important feature introduced for the first time in a bridge of this great magnitude is that practically the whole of the Hudson River Bridge will be weatherproof. That is to say, its steelwork will be so completely enclosed with rain-and-moisture-excluding material that the annual cost of repainting—a most serious item in the upkeep of a big bridge—will be reduced to a minimum. We have seen that the towers and cables will be so protected. The upper deck of the bridge being watertight, it follows that the whole of the steelwork below it, including the floorbeams, girders, tracks, et cetera, will be similarly protected. Each chain cable, as above stated, will be enclosed in a continuous watertight tube or casing of bronze which will enable the bridge crew to make periodical inspection of the eyebars which compose the cables. The result of this weatherproofing is that only 15 per cent of the steelwork will be exposed. Were it not for this protective feature, the annual bill for painting the scores of acres of surface of the bridge would amount to at least $500,000. Because of the weatherproofing the annual cost for painting will be but a fraction of this sum.

A Comparison of Weights

As may well be imagined, the weight of the steel in a bridge of these proportions runs up to a very high figure, and in the drawing at the bottom of the page an attempt is made to bring home this fact by comparing the bridge with three of the huge transatlantic liners which are themselves so impressive as to their length, height and bulk. We find, on drawing the ships to exact scale that the "Olympic," the "Leviathan" and "Aquitania" could be placed on the floor of the main span and still leave some 400 feet to spare. Still more remarkable is the fact that the combined weight of these three vessels, when loaded, which is about 160,000 tons, would fall far short of the unloaded weight of the main span of the bridge.

The Heavens in June, 1921

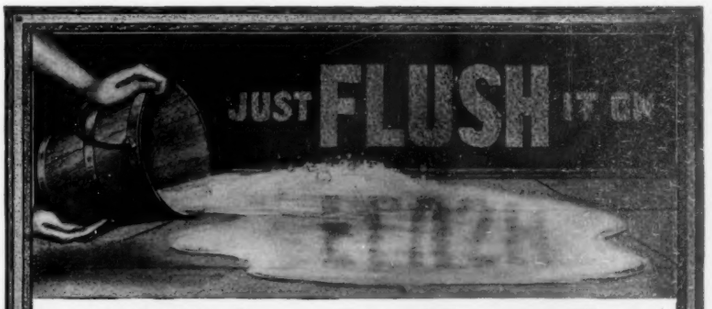
(*Continued from page 452*)

of radioactivity indicate that the crust of the earth is at least one billion years old—and probably twice that—and less than eight billion years old. If then we may say in round numbers that this world of ours is three or four billion years old, our estimate seems unlikely to be twice too great, or twice too small.

Two things should, however, expressly be said. First, these estimates depend upon the assumption that the forces known to science (at present) are at work, and no others. We can obviously do nothing better than this; but future discoveries may upset this argument completely, as they did Lord Kelvin's. Second, we are setting a limit only to the age of the *earth's crust*. If, as many astronomers think, the planets were formed at some remote period by some huge eruption from the sun, occasioned by the passage of another star close to it, the date we are attempting to fix may be identified with that of this giant catastrophe. What happened to the matter which was later to compose the earth, while it was still a part of the sun, he would indeed be a bold man who would define. There may be still heavier atoms in the sun, which break down and form uranium. Or perhaps it may be that under the enormous temperatures and pressures that prevail in the sun's interior, energy is put into atoms in some way, and heavy ones like uranium are built up. We pass here beyond the present limits of our knowledge, and it would not be safe to extend chains of similar reasoning further in the attempt to set an age for the sun. As for the age of the universe as a whole—if our little planet is so old, what limits, even in imagination, dare we set for the life of the vast galaxy in which it, and all our system, is but a speck?

The Heavens

The finest part of the sky is now in the south. On the meridian we find Scorpio, the great red star Antares (probably a rival of Betelguese in real size) blazing at the creature's heart, and the long line of the tail sweeping down to the horizon and curving back to form the sting. To the left is Sagittarius, with the little Milk Dipper. Above this is a magnificent region of the Milky Way, full of bright star clouds, clusters, nebulæ, and all sorts of interesting objects. One cloud, about midway between Gamma Sagittarius and Lambda Scorpii, fairly rivals the famous cluster in Perseus.



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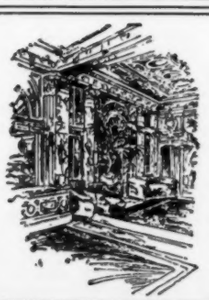

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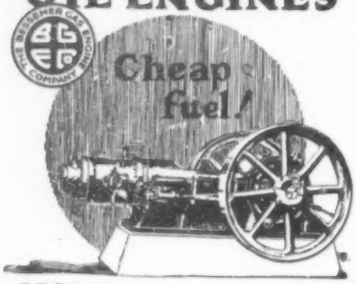

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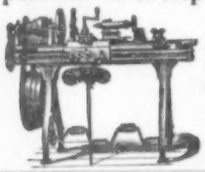

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Following the great arch of the Milky Way up to the eastward, we come upon Aquila and then Cygnus, with Lyra above; then passing the duller region of Cepheus we reach Cassiopeia low in the north. Draco and Ursa Minor are above the pole, and Ursa Major is descending in the northwest. Leo is sinking in the west, carrying Jupiter and Saturn with him. Virgo is well up in the southwest and Bootes higher. Hercules and Corona are overhead, with Ophiuchus and Serpens filling the space beneath them.

The Planets

Mercury is an evening star this month, and is very favorably placed, especially about the time of elongation on the 11th. He is then 24 degrees east of the sun, and the same distance north of the celestial equator, so that he remains above the horizon until 9:12 P. M. (This hour, like all others in the present summary, is standard time, and not the daylight saving variety.) He is then in the middle of Gemini, and appears as a star of the first magnitude, exceeding both Castor and Pollux.

Venus is now a morning star, drawing steadily away from the sun, and is very bright. At the beginning of the month she rises at 2:40 A. M., while at its end she comes into sight at 2 o'clock. Telescopically she appears as a wide crescent, while she is readily visible to the naked eye in broad daylight, if only the observer has something to guide his vision to her.

Mars is in conjunction with the sun on the 29th, and is invisible all this month—and next month too.

Jupiter and Saturn are close together in Leo, about 8 degrees apart at the beginning of the month, and 6 degrees at the end. They are past quadrature and set about half an hour after midnight on the 1st, and about 10:30 P. M. on the 30th. Saturn's rings are turned so that we see their dark side all this month, hence they will be invisible in small telescopes, while in giant ones the "condensations" may be seen which mark the places where sunlight filters feebly through the interstices between the particles which compose the ring.

Uranus is in Aquarius and comes to the meridian at 5 A. M. in the middle of the month. Neptune is in Cancer and is an evening star, setting at about 9 P. M.

The moon is new at 1 A. M. on the 6th, in her first quarter at 4 P. M. on the 12th, full at 5 A. M. on the 20th, and in her last quarter at 8 A. M. on the 28th. She is nearest the earth on the 8th, and farthest away on the 23rd. During the month she comes into conjunction with Venus on the morning of the 3rd, Mars on the 6th, Mercury on the 7th, Neptune on the 9th, Jupiter and Saturn on the 12th, and Uranus on the 26th. The conjunction with Venus is fairly close, but occurs before the planet has risen in our longitude.

The Canal Lock

(*Continued from page 453*)

rection 90 degrees apart. The bars are provided with beveled stops, known as "dogs," designed to engage one another. When these dogs meet it is impossible to move one bar until the turning of a control handle has lifted the dog out of the way. Other control handles meanwhile are locked out of action. The advantage of this arrangement is that there is no possibility of an incorrect sequence of control. No handle can be turned out of its proper order, so that the operator cannot move handle No. 4 before he turns handle No. 3—a proceeding which might empty the water out of a lock while the vessel was still in the lock chamber.—By *Ralph Howard.*

The Earth-Boring Machine

(*Continued from page 453*)

mechanically or by gravity. An improvement on augers heretofore used is an earth-retaining gate developed by the above officials. The difficulty experienced with the standard type of auger was that a considerable amount of earth would fall from it when raised from the hole.

The speed at which the auger is fed is, of course, dependent upon the nature of the soil. A hole six feet deep, twenty-two inches in diameter, can be bored on an average of seven minutes, considering all classes of soil. For hard-pan, the auger must be turned slowly to prevent the cutting edges of the auger from being burned. It may be said here that the cutting edges are replaceable, which fact lengthens the life of the auger. These cutting edges, two in number, are placed at an angle such as is found in a standard twist drill.

The Surveying Searchlight

(*Continued from page 453*)

establishing accurate geographical positions. Certain points conveniently distributed over the United States are located astronomically with exactness, and from these points are determined other positions; for instance, in the survey of a city lot or farm. Geographical positions are determined by the triangulation method; that is, three points which are accessible and visible from each other are selected to form the corners of a triangle. The angles of the latter, frequently extending from 10 to 100 miles, in order to be measured have their corners rendered visible to the observer.

Sunlight is an ally, when a mirror reflects the rays, in surveying. Not all days are favored with sunshine, fog and smoke frequently interrupting the operations of Uncle Sam's surveyors. Night observations are likewise sometimes to be desired. Hence the purposes of the signal lamp, which in addition to reflecting an intense light, is portable, a factor to be appreciated when surveyors travel afoot and convey their burdens in pack-horse fashion. The new lamp functions when connected with a battery of three dry cells, whereas its predecessor fed from a series of six and consumed power somewhat extravagantly.

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Is Your Watch Accurate?

(*Continued from page 454*)

ing under laboratory observations for rate in five positions and at three temperatures.

The rate of any watch is largely influenced by two factors, the position in which the timepiece is running and the temperature. The Bureau of Standards railroad precision watch test particularly emphasizes adjustment for satisfactory running in different positions. During the 19-day test the rate of the timepiece is determined in five positions and three temperatures. The performance of the watch is determined according to three criterions, two of which apply to position, and one each to temperature, recovery (repeatability), and regulation.

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